INTER AVIA

Review of World Aviation

In this Issue :

Airmen of the Antiquity

G. Brusasca : Italian Civil Aviation

Gold and Aluminium : The Financial Problem of British Flying Equipment

NC 2001 Helicopter — North American XB-45 — Martin 202

A. M. Schwartz : Genesis of the Northrop XB-35

H. L. Slotemaker : Freedom of the Air

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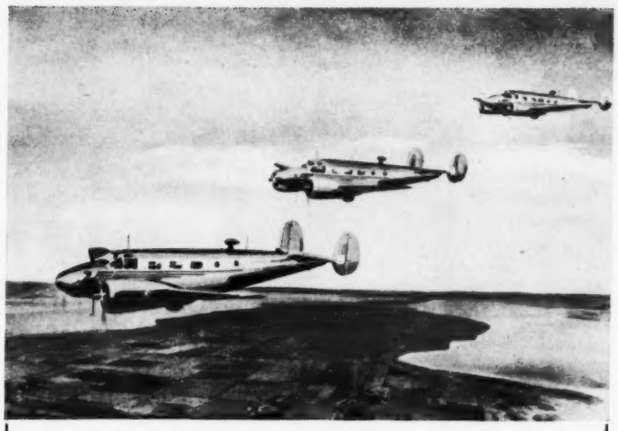

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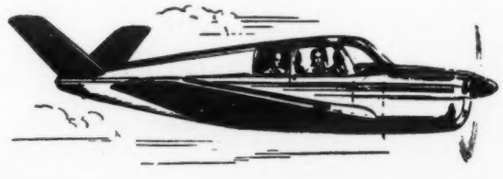

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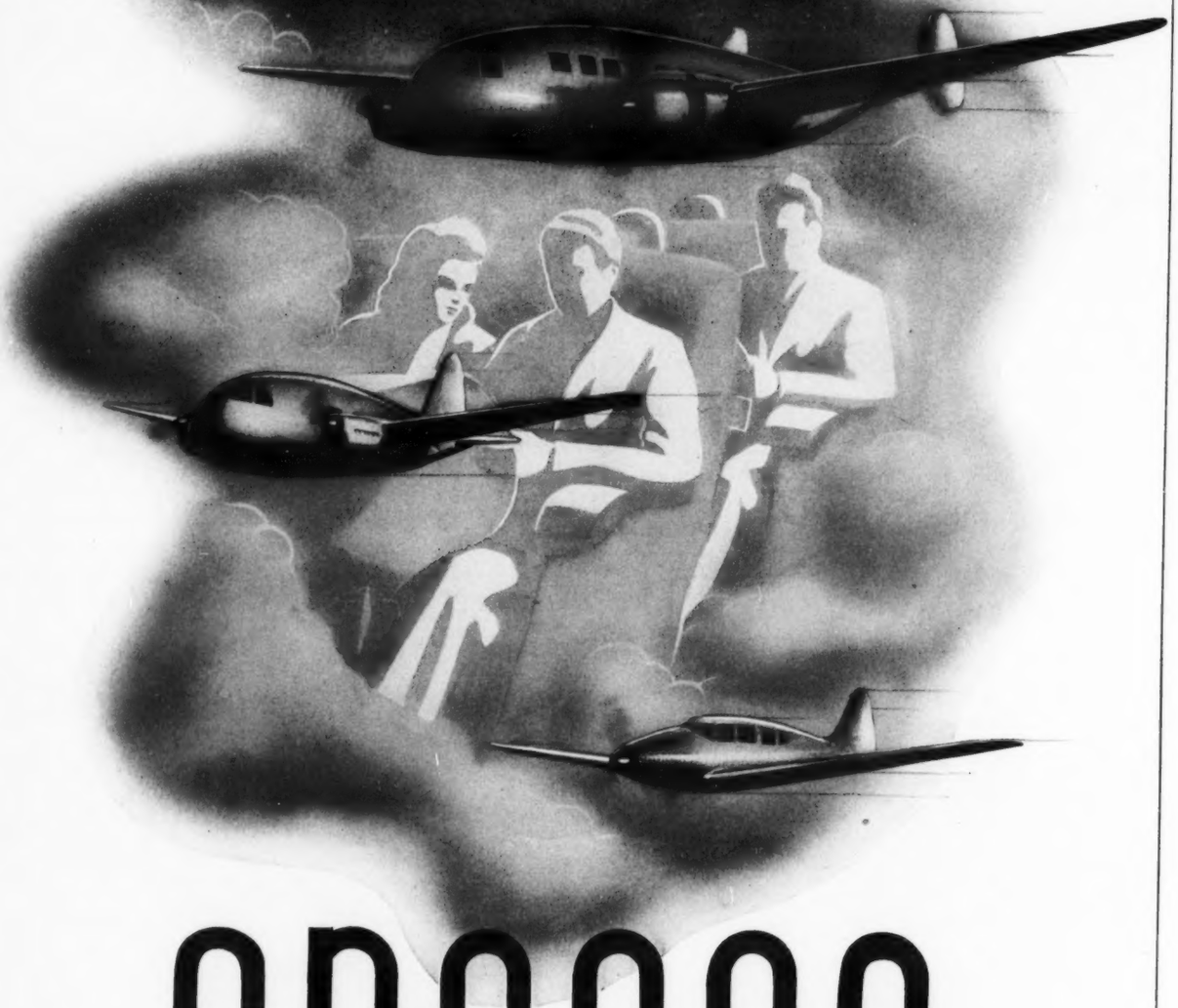

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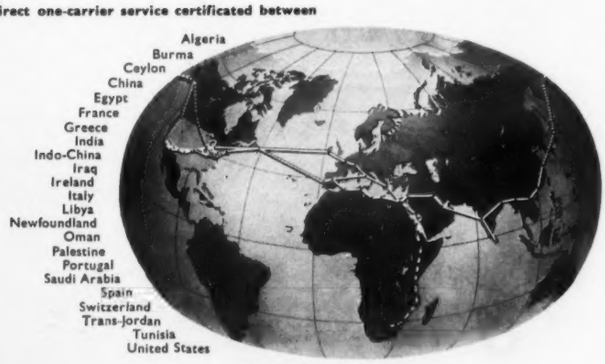

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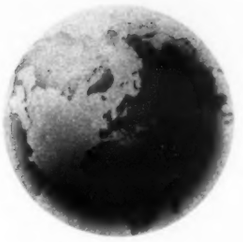


SERVICE TO CUSTOMERS

How to run a lucrative route at a loss

It was a usual early spring day in London : rain, wind, and only seldom glimpses of the sun. The rendezvous at Airways Terminal was for 2.50 p. m., in order to catch the bus for Northolt Airport at 3.07 p. m. and to leave with the British European Airways plane at about 4 o'clock. All being well, it was to land at Le Bourget, Paris, at 5.35 p. m. It had been my first intention to leave the day before, but business prevented my leaving London. My first ticket remained unsold ; my own fault. But it was also a sign that passengers were no longer so anxious to get seats on aircraft. The incidents of the winter season had effectively not been forgotten ; this may change with the advent of summer.

My arrival was punctual. Ticket control, preliminary examinations of passports, and luggage procedure, was all concluded in exemplary fashion ; the more tedious and time-losing, final control was to be at Northolt. In the spacious halls of London's Airways Terminal—together with Air France's Paris facilities at the Gare des Invalides, a proud symbol of European aviation—were seated numerous passengers with their friends. Suddenly the loudspeaker called out : Brief delay for BEA passengers for Paris ; buses leaving about 30 minutes later. I bade farewell to my friend, who was to travel back to his country home, and waited patiently. The loudspeaker called out constantly : Passengers by American Overseas Airlines for New York, British Overseas Airways for India, South Africa ; Swedish, Belgian and other airline companies were mentioned. There were British officers in tropical uniforms, and worthy Government officials holding umbrellas and tropical helmets, about to leave for outposts of the Empire ; Hindus, Mohammedans, women and children : all comfortably waiting for the departure. It gave an impression of being at a central point of world transportation. It was like a breath of all the British Empire.

The loudspeaker gave us no peace ; almost too much of a good thing. Why not also have luminous signs on panels ? Some people are deaf and, besides, the loudspeaker's accoustics are by no means music to normal ears. After nearly one hour, the anonymous voice of the loudspeaker informed me that, owing to technical reasons, the take-off of the BEA plane for Paris was again to be delayed a little. "Technical reasons ?" Rather a vague term, what ? That evening I had to meet an important person in French aviation ; I absolutely had to know what was to happen. — Was there to be a take-off at all ? But of course, Sir ! — After waiting until half past four I asked again, to receive the same reply. Suddenly I perceived a fat little man with an amazing moustache r. through the building like Falstaff making for a tankard. I promptly asked the official again, but he had nothing further to report. At 5 o'clock I began to insist emphatically. And, with honest regret in his voice, he replied : "Very sorry indeed, Sir. We have to cancel the flight because of bad weather over Paris."

Twenty people, full occupancy of a Douglas "Dakota," had been left to wait in uncertainty for about two and a quarter hours. It meant that twenty people had wasted their time and were faced with all their plans disturbed. Why not be frank right from the beginning ? Why all the secrecy ? Passengers cannot be treated just like spoilt children.

Back in the City, our office found out that night-trains and night-boats over the Channel only run twice weekly, and of course not on Fridays ; further, that all seats on the Saturday morning train—both on the usual one and on the "Golden Arrow"—were sold out. After some trouble, a hotel room was found for me and, towards evening, a friend secured me accomodation on the "Golden Arrow". Over dinner, I met a few friends from British aviation circles, and in chorus we all grumbled about British civil flying. In the meantime, I had learned by telephone that the Air France plane had left half an hour after the cancelled BEA take-off, and had landed safely in Paris. A subsequent weather report indicated improved visibility towards 4.30 p. m. over Le Bourget, and a ceiling between 3,000 and 4,500 feet. But this implies no criticism of the pilot. He carries the responsibility ; his decision must be final. It is a fact that the ground service is not perfect anywhere, neither in London, nor in Paris ; and that applies to nearly everywhere. Irregularities in transport are inevitable.

Next day I travelled through the English countryside, bound for Dover. The customs facilities in Dover were accomplished rapidly and smoothly. The seats on board the ship were comfortable. There were hundreds of passengers, of all nationalities, eating, drinking, chatting, smoking ; and thus the time passed quickly and Calais was soon reached.

Another pullman train : efficiency, courtesy. A lunch was served which no one could criticise. After coffee had been served, French officials passed through the coaches for the passport and customs formalities : all concluded smoothly and quickly. Time flew and the train steamed into the Gare du Nord : 6.00 p. m., arrival in Paris. A whole day had been lost.

And now let us compare and reflect : What is wrong with the airlines ? Or as a prominent American periodical recently put it : "What is wrong with European aviation, particularly between London and Paris ?"

The British and the French fly six return trips daily with "Dakotas", and can therefore carry, at the most, 126 passengers in each direction between them. Before the war, Imperial Airways and Air France flew about twelve trips daily in each direction, and British Airways at least another half a dozen journeys. At that time they flew the most modern equipment available ; Imperial Airways, for instance, flew Handley Page "Hannibal" four-engined transports, which were slow but accommodated 42 passengers in reasonable comfort. Before the war, customs and passport formalities were considerably simpler, and time was saved. Provided the weather was not really too bad, everything went off fine. Today ? British customs officials are politeness personified. But they examine travellers and their luggage as if they were hunting for wanted criminals. All right : duty is duty ! But facts have shown that a person with the talents of a Stavisky—no matter what nationality—can deceive these officials ; all they manage to bag consists of, at the most, a pair of nylons, chocolate, cigarettes, or other such harmless commodities that some innocent Englishman has bought on the Continent. Gold and foreign bills of exchange ? Swindlers usually get through with what they want. To sum it up : Much ado about nothing, and a whacking loss of time to boot. Long live pullman trains, where at least no time is lost by all this fiddling, as everything takes place en route.

Let us continue : Effectively, there is not another route in Europe, that is to say, a short route, which is so well suited to air connections as that between London and Paris. Passengers are spared the complications of changing from the train to the boat and vice versa. Those who are prone to sea-sickness find no delight in the Channel's caprices. And thus it happened that, during the carefree pre-war times, the London—Paris route was perhaps the only one in Europe which warranted an existance and paid its way.

The British have been airminded for years and it is already long ago since they were won over by flying as a means of transport. They themselves were the best customers on their own national services, particularly on the Paris run. Today ? Today, they go by boat. And not because they are no longer airminded. But because they have no desire to lose time and—they also read the newspapers !—to risk their lives in the "Dakota" aircraft, which have lately figured in quite a number of crashes. The result is that every day a few hundred travel by boat and train. *Voilà !*

Is it right that this state of affairs should be allowed to continue ? Is the shortage of aircraft to be used eternally as an excuse ? Is it justifiable that four-engined transports and first-class crews should be kept for long-distance services only ? The present methods can never pay their way ; this was evident even before the war.

What is the use of repeating that, in America, an aircraft travels every few minutes between New York and Washington ? There is no reason why we should not have the same sort of thing in Europe ; and the London-Paris route is still an artery of economic life. But the pulse in this artery will have to beat stronger if the present air service is to be reanimated. I recall how a former business friend of mine, Henri Bouché —who knew his job and today represents France in Montreal—was enthusiastic before the war in his description of the Paris-London run as a perfect example of a lucrative air route. But if he were to fly it today ! . . .

And when I got to my hotel in Paris and opened the newspaper I found an advertisement for BEA, stating that this airline, with its London-Paris service, bridged the Channel and all its unpleasantness.

Do the airlines take the public for fools ! Has the conception of service to customers entirely disappeared ? Even the most lucrative of air routes can be operated at a loss if, in 1947, it is flown in a way which would perhaps have been acceptable in 1927.

EEH.

AIRMEN OF THE ANTIQUITY

BY DR. M. HOFMANN

Names of men such as the Wright brothers, the Farman brothers, Lilienthal, and their followers are familiar to those interested in aviation. They mark a short epoch which, though it must be regarded from a historical point of view, quickly entered the technical domain.

Icarus, Phaethon, and many other characters from the tales of the antiquity are known to even the least learned.

Why not touch upon the foundation stone of modern aviation? Why not deal in a summary way with how the problem of human flight was repeatedly tackled long, long ago in the Near East, in the days of Greek and Roman culture?

This is the purpose of the following lines, which are both interesting and conducive to thought.

The Editor.

I.

Seeing that the question : " Where goest thou, Icarus ? " was recently asked in these pages, we would now like to put the query the other way round : " Whence comest thou, Icarus, mythical father of flying ? Art thou a human, a bird, a star, a god ? What art thou, or what wert thou once ? " (Fig. 1.)

But for this, we must go deep down — or perhaps high up—to the domain of the classical myths, where the childish fantasy of man was light-winged and opalescent like a blue bird, or like Sirius and Orion, the brightest of the stars.

It is not by chance that we have chosen this comparison. For else, whence did the antiquity derive the human characters which it had fly heavenwards in fiery chariots, or with huge wings attached to their shoulders and limbs ? If we trace back through the oldest legends and myths of Europe and the Near East, woven in the pattern of the Bible, Homer, Greek poetry, and the Thousand and One Nights, we repeatedly stumble upon heroes and immortals who flew ; and these two phenomena always figured : birds and fiery stars.

Fig. 1 : Icarus, to whom his father, Daedalus, attaches wings. (Gems of the British Museum, No. 3134, from Greek-Roman period.)

II.

" Ah that no wings are mine to mount, to soar,
To follow in his wake and all explore, "

Faust exclaimed, as he watched the setting sun. And straight away he wished :

" Oh that a magic cloak were mine
To bear me to some distant shore. "

In these few lines, Goethe has expressed the whole complex of ancient human desire : the dream of flight, dreamed at night by each of us during childhood, and for which the whole human race has worked every day for centuries in order to make reality : in the aeroplane, whose planes so strikingly resemble a bird's wings — in the jet aircraft, which shoots across the skies like a fiery star.

But whence the " magic cloak ? " It may have been derived from the cloak of the Prophet Elijah, which remained behind when " there appeared a chariot of fire and horses of fire . . . and Elijah went up by a whirlwind into heaven. " Folklore has it that God's prophet, wrapped in this cloak, still flies through the air.

How strongly this chariot of fire with horses of fire of the Biblical prophet reminds us of the fiery chariot of Helios, the sun-god of Greek mythology (Fig. 2).

It is told of Helios, the sun-god, that he was the father of a mortal son, Phaethon, a comely youth who wanted to drive the chariot of the Sun.

" *Sors tua mortalis : Non est mortale quod optas.* "

" Only thy lot is mortal : thy yearning, though, is immortal "

are, according to Ovid, the words of fatherly warning from the only authorised pilot of the chariot of the Sun. Nevertheless, his warning was in vain. The young flyer ascended steeply from the east—higher and higher : amid the picturesque Zodiac, he lost his way, lost control of the horses, was struck by Zeus' thunderbolt and crashed in the west : a subterraneous fire ensued, which it required all the rivers and seas to quench, until finally, there was to remain a flood . . .

" He fell like a star which seemed to crash down from the heavens ", said the Roman poet, Ovid, who —drawing on much older sources—describes all the details of the first crash in flames of an aircraft, with supreme professional knowledge and skill. The sisters of the unfortunate pilot, the Heliades, placed

Fig. 2 : Chariot of the Sun (winged goddess of victory, Nike. Gems of the British Museum, No. 569. Vth. Cent. B. C. Classical Greek masterpiece).

a gravestone over his remains, upon which was written :

Here lieth Phaethon.
It was not for him to master Helios' fiery steeds.
But he was great, for he dared to do great things.

The victim's burial ceremony was more impressive than that given today for a successful millionaire of the air, or an ace fighter pilot. His death was followed by a day of darkness, either because Father Helios mourned so deeply for his son—or because his aircraft was so far beyond repair . . .

III.

This sorrow of a father who, with his own eyes, had to watch his son crash, is found again in the story of Daedalus and Icarus, the classical aviators of the antiquity.

The tragic crash of the ingenious apparatus which the master Daedalus had made for his son, Icarus, in order to flee from Crete and the wicked King Minos, was brought to the Attic stage by the best Greek dramatists, such as Sophocles and Euripides.

Fig. 3 : Daedalus attaching the apparatus to his son.

Fig. 4 : Icarus, with wide-spread wings, flying above the surging waves.

The amazed onlookers saw on the stage how the father familiarised his son in the working of a bird-like machine. Meanwhile, in his comedy " The Frogs", Aristophanes, the sharpest punster of Athens, chose to make fun of this tendency for flying. Nevertheless, thanks to the technical aspect of man's earliest attempts to soar, flying remained deeply imbedded in the minds of the Greek and Italian peoples.

Even Leonardo da Vinci was to be captured by the spell of this tradition, which had influenced art since the Vth century B. C. ; and particularly in Roman times, formed the favourite motive of gem-cutters and engravers.

" Those who saw them, took them to be gods ", Ovid said, whose verses constitute the best-remembered and most complete description of this flight. In his famous book " Ars Amatoria " (The Art of Love), which is much more innocent than its name might imply, Ovid goes on to describe how the tender father trained his son in the way of the birds on land to start with, before the pair decided to take to flight over the open sea.

" Erudit infirmas ut sua mater aves. "

" He taught him as would a mother her fledglings ", are the poet's words. But the love and prudence of this ingenious inventor were of as little avail as the warning words of Helios to his son. Youth craves to reach the skies—and notably a record flyer like Icarus, who came as near to the sun as did only Orion, the morning star. And just as this disappears in the rays of the sun, carried away by Eos, the dawn, Icarus dwindled and crashed into the stormy waves of the Aegean, the wax of his wings having melted. The waves carried him to the shelter of an island, named Icaria after him. Still perceiving him, his father calls anxiously after him—" Alas, he was no longer a father, " as Ovid says :

" Icare, clamat, ubi es? Quoque sub axe volas? "

" Where art thou, Icarus ? In what direction fliest thou ? " But Icarus has already taken his demise, and all that a bewildered Daedalus is left to bury are the pale, lifeless remains of a Greek youth. In the days of the Roman Empire, when it was customary to recount the destinies of the heroes without letting them spoil one's appetite, the tale of Icarus was transformed into a love story with a happy ending : seeing that he met with so little success in aviation, Icarus turned to sailing ; and is designated as the inventor of this sport. He built himself a stately yacht and took beautiful Erigone for a cruise over the Icarian Sea. It is around this period that the gems and cameos were engraved, which are shown in the accompanying illustrations. Meanwhile, later poems and legends tend rather to portray the downfall of Icarus as symbolic of the dwindling in the vicinity of the sun of Orion, afterwards called Phosphorus or Luciferus.

IV.

Bellerophon, who captured and mounted the winged steed Pegasus (Fig. 5), was almost worshipped in the Near East and many parts of the Greek mainland as victor of light over darkness, of good over evil. All old Corinthian coins bear the emblem of Pegasus. In one of his " Odes to Victory ", Pindar, the Greek lyric poet of the Vth Century, B. C., warns mankind to undertake nothing superhuman. As example, he uses Bellerophon, who was thrown by Pegasus because he wanted to fly too high, and to spy on the gods. This, however, was not for mortal eyes.

Is this not again reminiscent of the words of Helios to his son Phaethon, likewise a mortal ; and of the downfall of Icarus ? And, all the same, man never learned not to attempt the superhuman, and never ceased to dream of flying — until he ultimately succeeded in making this dream reality.

V.

A simile of Bellerophon riding—or flying—his winged steed is to be found later in the very well-known story of the " Golden Fleece ", where not only one, but two, youthful airmen fly eastward over the sea, this time on a winged ram. They are Phryxus and Helle, the children of King Athamas, who were fleeing from their wicked stepmother on a winged ram with a luminous fleece, sent by their real mother who was unfortunately dead. Originally, the little sister, Helle, who accompanied her brother Phryxus, did not belong to the story, and was therefore " dropped ". And she did actually drop—a feminine counterpart to Icarus — into the waves of the Pontus, named " Hellespont " after her until this day. Phryxus, however, reached Colchis on his horned aerodyne, which the unthankful individual promptly sacrificed to Zeus, nailing its fleece to a tree.

VI.

The aeronautical legendes of the antiquity can be divided into two main groups : The stormers of the heavens : daring flyers who acted of their own free will — or still rather against the wills of those who loved them. The most prominent of these are Icarus, Bellerophon, Perseus, and by no means last, the daring Phaethon, whose flight towards the sun has been recounted so masterfully by the poets, who

Fig. 5 : Pegasus ; (Gems of the British Museum, XXXI 3114. Fine work from Hellenic period).

Fig. 6 : Antonio Allegri da Correggio (1488-1534). Painting : " Ganymede Abducted by the Eagle ". (Kunsthistorisches Museum, Vienna.)

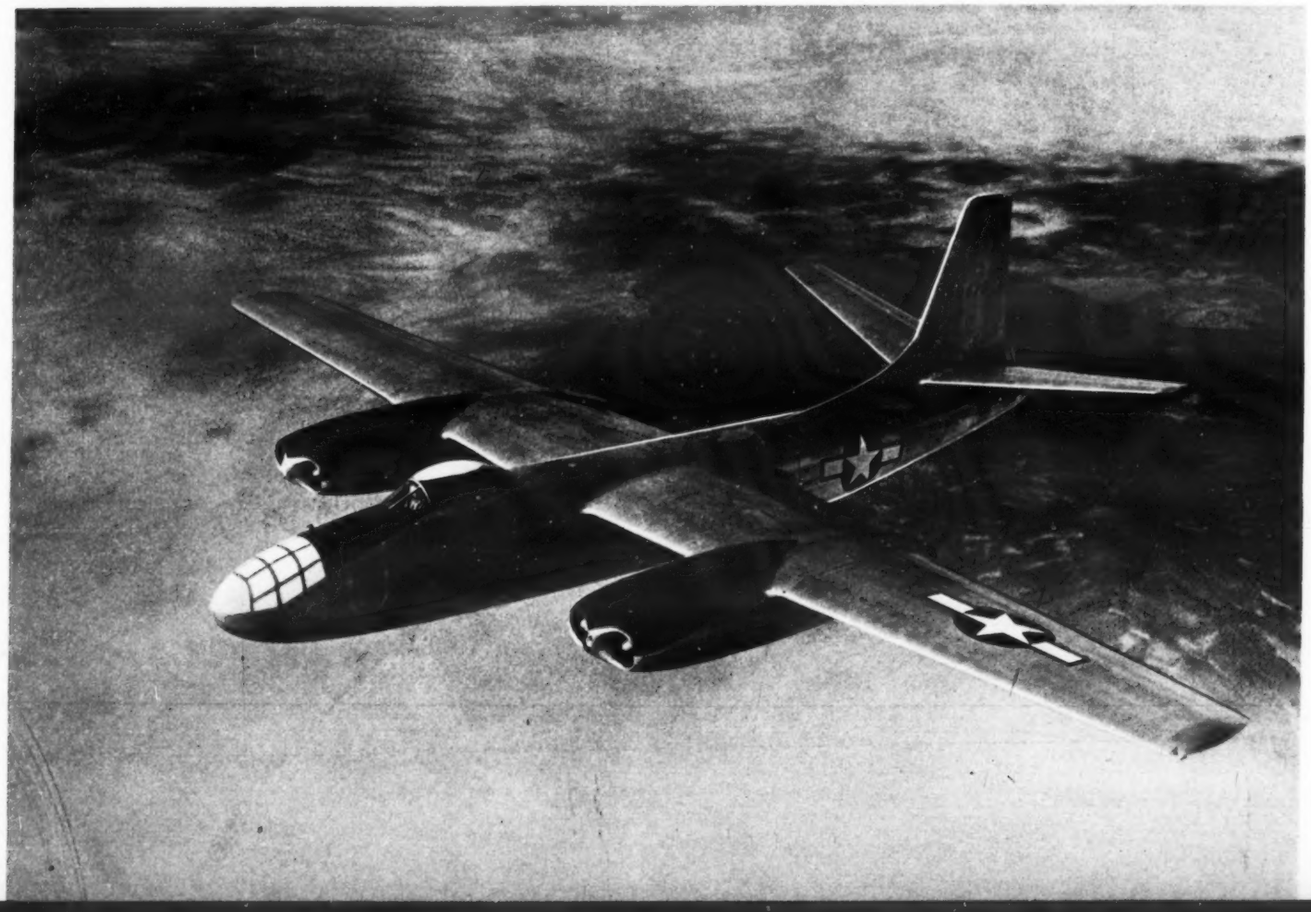
state that the youth was spurred by doubters of his real descendancy from the god Helios, and forced " to show them ".

The other group comprises those who were forced against their wishes. To these belong Phryxus and Helle, Peresphone, and also Orion, the sweetheart of Eos. The classical example of this group is, however, the Trojan, Ganymede, who Zeus carried to Olympus, where he was served by him as cup-bearer and loved him to such an extent that Hera (Juno), the consort of Zeus, became jealous. Ganymede's aircraft was an eagle, which bore him on mighty wings through Zeus' serene skies. Learned poets and theologists of the antiquity were in hot dispute as to whether the eagle was merely a messenger, a symbol of Zeus—or else that the Olympian had effectively assumed the form of an eagle.

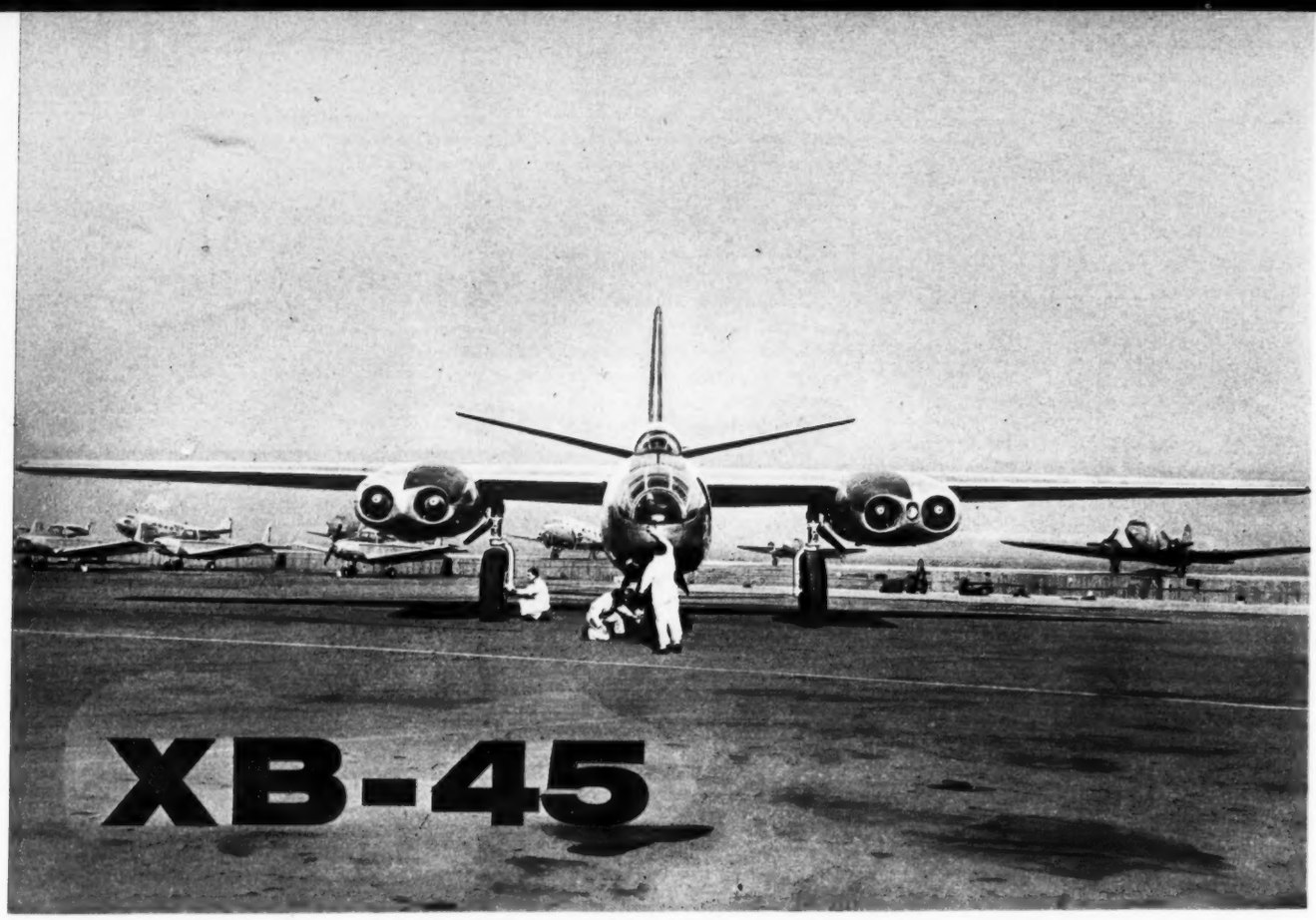
Later on, the Greek satirist, Lucian, and various Roman caricaturists treated the subject as a farce. Instead of the handsome Trojan, we find a monkey being abducted, which wears the pointed Phrygian cap worn by Ganymede.

But what created the longest lasting effect, as a symbol and an idea, and what managed to inspire Correggio (Fig. 6), was the vision of the beauty of human flight on the giant wings of a bird—likened unto the gods.

March 17th, 1947, marked the end of a race which—without the public's knowledge—had held the engineers and staffs of two American aircraft firms spellbound for months : On this day the first U. S. four-engined jet bomber took to the air. Consolidated Vultee Aircraft Corp., of San Diego, Calif., had announced the completion already several weeks ago of their four-jet bomber, the Convair XB-46 (cf. "INTERAVIA, Review of World Aviation", February, 1947, P. 53) ; its test flight must, however, have been postponed owing to technical setbacks, for it was finally North American Aviation, Inc., who were to win the race when their prototype XB-45 effected its first flight at the AAF's Muroc Field test base. The XB-45 is the first aircraft of a series of 96 units ordered by the Army at a cost of $ 73,900,000.



The performance, which this first flight of over an hour gave to expect, is heavily veiled in secrecy ; it is merely stated that the new aircraft's speed is " very high ". The XB-45 is an all-metal mid- to high-wing monoplane with tricycle landing gear, the landing wheels being attached directly inboard of the engine nacelles and retracting laterally into the wing centre section ; in view of the thinness of the wing, the tires are designed exceptionally thin. The single fin and rudder unit is attached above the fuselage tail, the tail plane featuring a marked upward dihedral. Four General Electric I-35 jet engines (built under license by the Allison Division of General Motors) are grouped in pairs and located beneath the wing in such a way that the entire turbines are located fore of the leading engine ; maintenance



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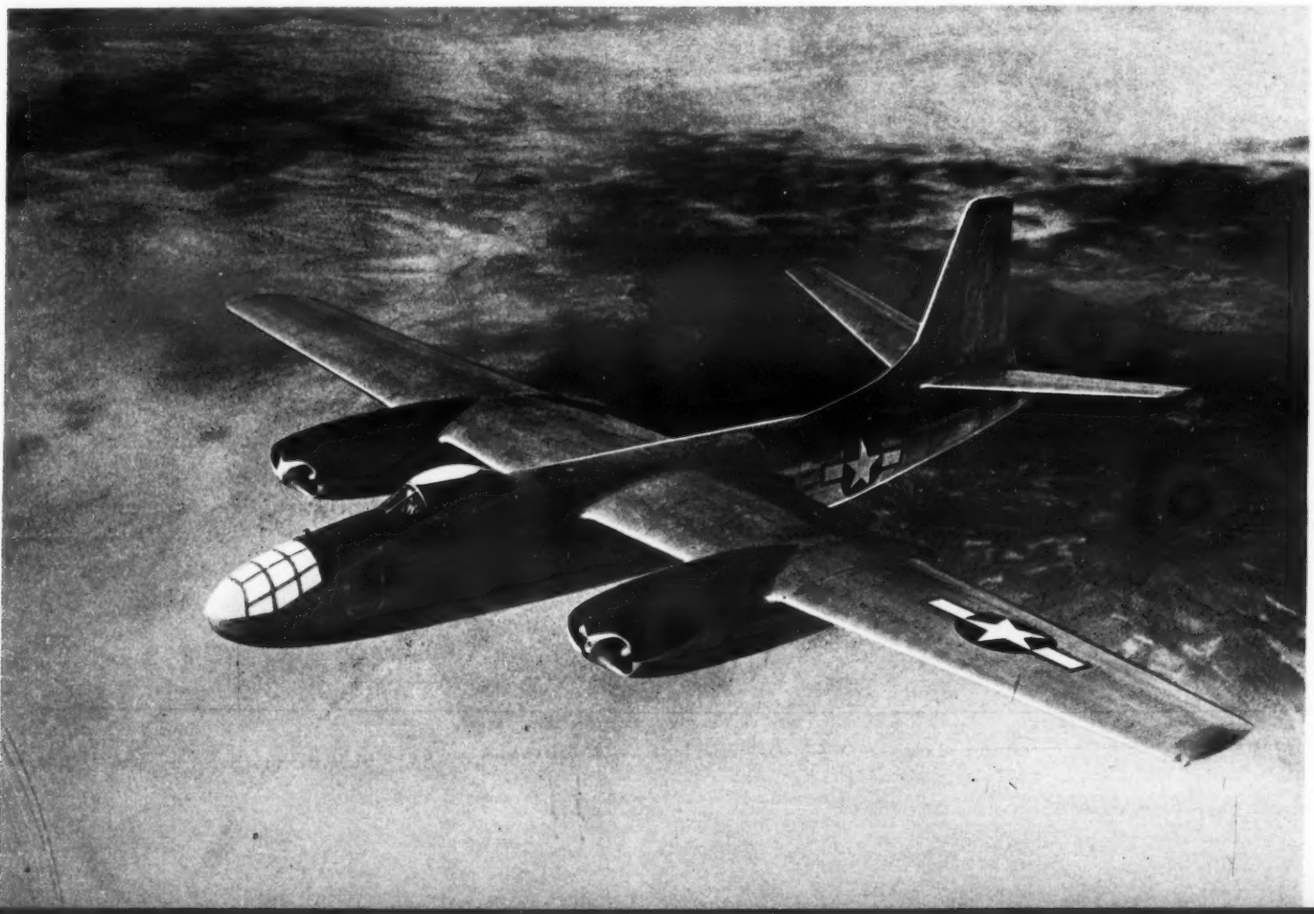

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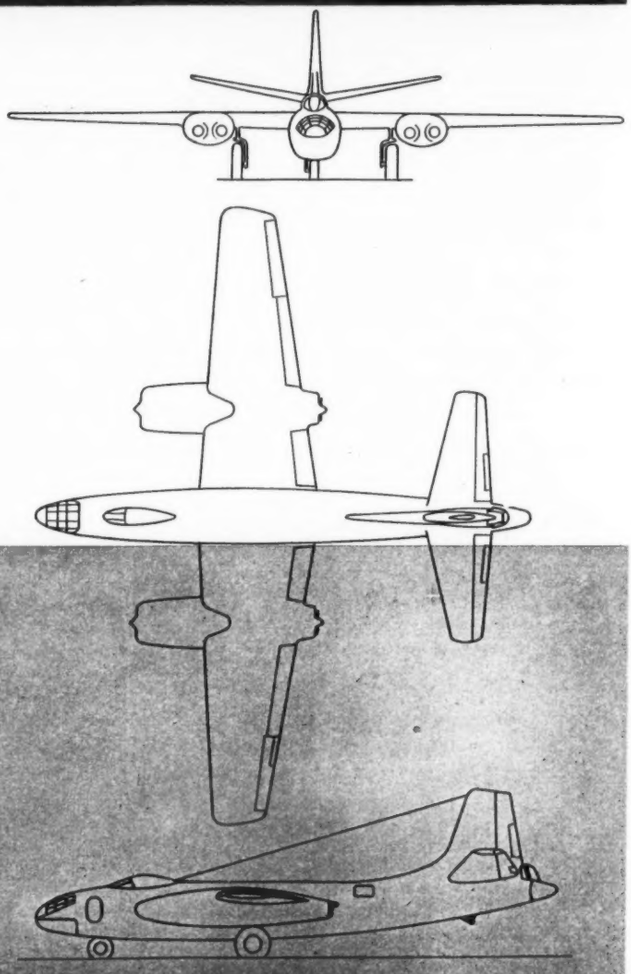
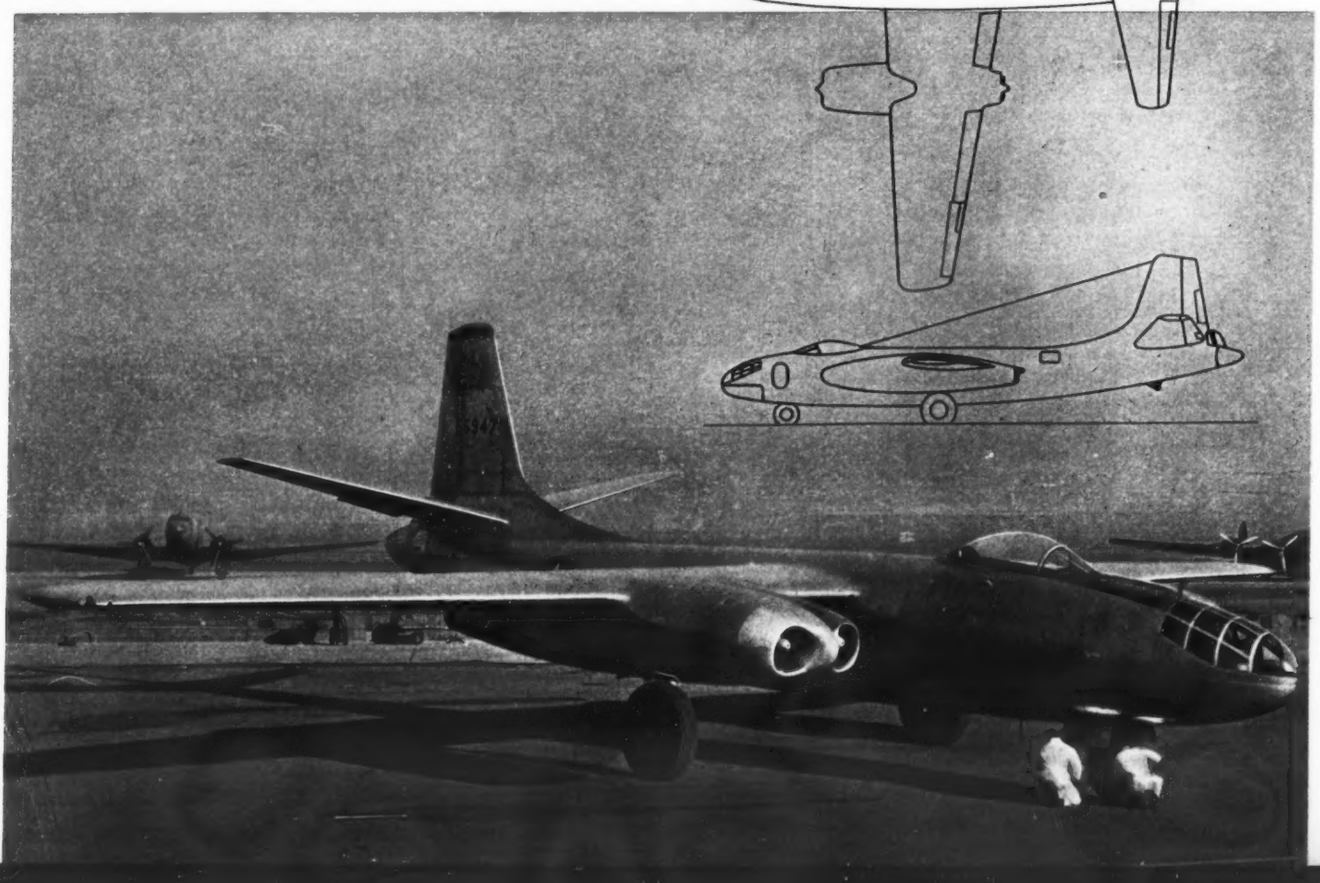
is thus considerably simplified. Bombs are carried in a bomb-bay situated in the centre fuselage, whilst there is a rear defence station, of which the armament seems to be located in the tail extremity of the fuselage. Although all data concerning weight and performance are momentarily withheld, the payload of the XB-45 will in all probability exceed that of wartime four-engined bombers. Besides the pilot, whose cockpit is in an elevated position on a level with the power plants, and enclosed by a transparent canopy, the XB-45 can also carry two to three additional crew members. Their stations are equipped with pressurisation for high altitude operations, and are provided with a heating and refrigeration system. — The XB-45 measures 89 ft. ½ in. in span, 74 ft. $^3/_4$ in. in length, and 25 ft. 2 in. in height. *Bi.*





1931 : Handley Page H. P. 42 "Hercules", safest and most luxurious transport of its day.

GOLD and Aluminium

THE FINANCIAL PROBLEM OF BRITISH FLYING EQUIPMENT

In the end it is always the facts themselves which tell the story, supply the figures, and put an end to unavailing discussion.

Notwithstanding frequent digressions into oranges, wine from abroad, tobacco, and more moderate living, the economic debate in the House of Commons (March 10th—12th) on the Government White Paper (Economic Survey for 1947) had, in the end, no choice but to deal with the all-important subject of exchange relations between the balance of payments and the balance of trade, even if this did take the form of a superior sort of professorial lecture.

Great Britain, who could allow herself an excess of imports of £ 464,000,000 in 1926, for example, and £ 263,000,000 in 1935, today finds herself—it cannot be expressed otherwise—threatened by an *excess of imports* amounting to £ 425,000,000. All that is to be found on the other side of the scales is—rightly termed—invisible exports worth £ 75,000,000. Increased exports, particularly into the dollar area ; and less imports from this area. Export or die ! This, it would seem, is the British Government's only recipe.

But, all in reckoning and debating these figures, people know perfectly well that such a course is, at the best, only an emergency procedure ; and curtailing a few luxury imports is no fundamental solution. Just for once, the way to freedom is forced to pass through the balance of payments. It is not possible to cut down British living standards artificially to an extent where the country could build up its future on an excess of exports, as certain nations with only natural resources usually do if they are short of capital.

It was not only her colonial possessions which made Great Britain a financial power ; it was her navy too. She served the whole world with her merchant navy and these services had to be paid for. In the call :

Rule Britannia,
Britannia rules the waves.
Britons never shall be slaves :

" slaves " implies political as well as economic independance.

Foreign possessions, and hence independance, cannot be acquired in a twinkling of an eye. Britons are finding themselves forced to tread the paths their forefathers trod : British ships must continue to ply the seas, carrying not only British goods, but also tendering British services. These are the new means of obtaining foreign credits, foreign capital investments and a return of a state of affairs which can snap its fingers at austerity. Only in this way can that man be ressurrected, who, when told that smoking cheaper cigars would enable him to save up enough money within ten years to buy the house he was admiring from the road, answers : " I've owned it for years. "

John Bull wants to regain his prosperity.

II

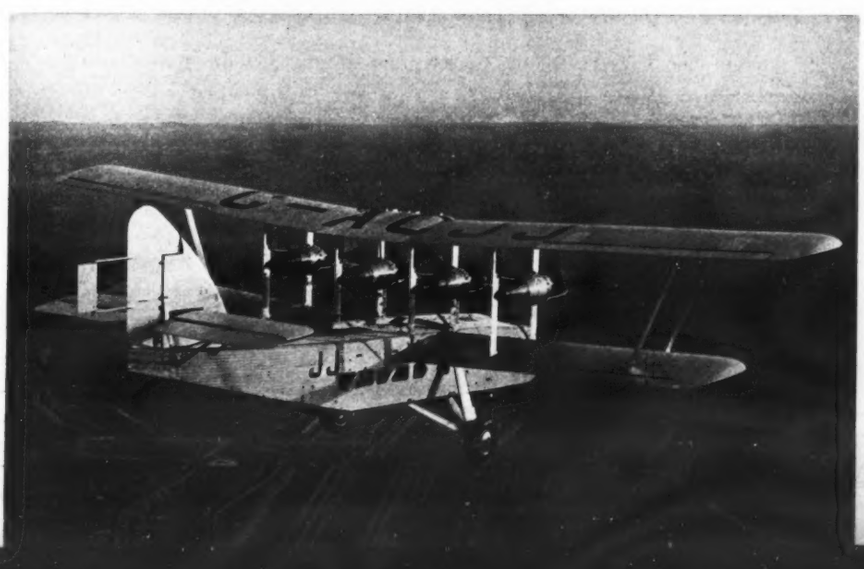
In air transportation, the large merchant vessels are represented by long-range transport aircraft. But right at the psychologically important moment when British transport needs to spread its services round the world, it finds itself without adequate British flying equipment.

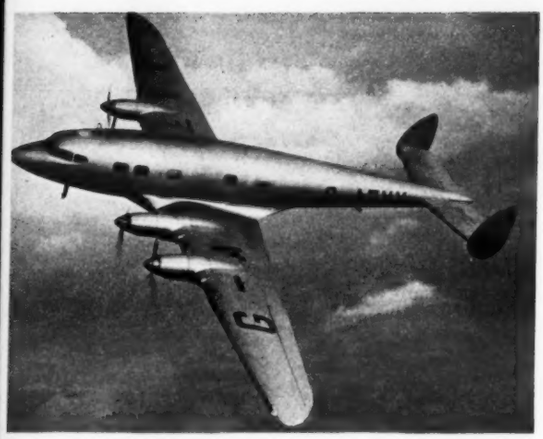
From an economic point of view, the historical and technical reasons for this state of affairs are more or less secondary. To a certain extent, all the same, it should be remembered that these reasons have a background of highest honour, summed up in the aforementioned parliamentary debate in Winston Churchill's own words : " None gave so freely from the beginning to the end of the war as we did. " And this can be applied to long-range transport aircraft, which Great Britain may be did not possess at the outbreak of war, but all the same had on the drawing boards. What happened when war broke out ? The Fairey FC-1 four-engined transport, for one, which was destined for trans-Atlantic and Empire trunk routes, was simply pushed aside. And there were more besides.

The old slogan of Imperial Airways, predecessor of British Overseas Airways Corporation—" Four engines for safety "— was forgotten. In 1940, when the British planning staffs called for heavy transports, the Government, airlines and industry had to answer : Sorry, we have none.

Over nine months ago, in August, 1946, the Chairman of British Overseas Airways, Lord Knollys, said that the " Tudor II ", Brabazon I, and the Saunders Roe flying-boat would be the first real post-war airliners in British aviation. But—they are not in the air yet ! According to Lord Nathan, who as Minister of Civil Aviation is a Crown witness, the Bristol Brabazon I may be in service by 1951. Hence, people are being stuffed with stories of a rosy future, which should simply not be believed.

1934 : Short " Scylla ", high-speed transport with " built-in headwind ".

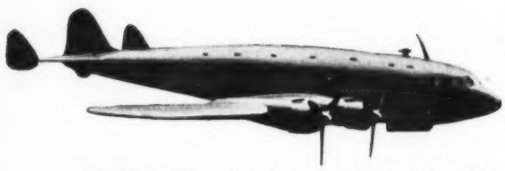




1938-1940 : The de Havilland "Albatross" was ahead of its day.

1938-1945 : The Armstrong-Whitworth "Ensign" was at first a disappointment, later during the war the "work-horse" in India.

The three airline Corporations complain bitterly. In a statement issued last February by British European Airways Corp., the shortage of large, fast transports was described as one of the carrier's major problems. British Overseas Airways Corp. have had to suspend the lucrative service from Cairo to Durban, South Africa, because their Short Empire flying-boats were worn out.



1938-1939 : Fairey F. C. 1, a promising project which never matured.

III

In article 27 of British Air Services, the Government paper of December 20th, 1945, it is stated : "It will be the general policy of His Majesty's Government to require the Corporations to use British aircraft types." However, the normal policy is also to buy goods which are available within reasonably short delivery periods ; and this does not yet apply to British long-range airliners. Hence, is it at all surprising if Britons occasionally let their eyes wander towards the U. S. A., where any shortage tends rather to be in customers than in airliners ?

There would be nothing novel in a decision by the Government to buy in the U.S.A. Quantities of American aircraft were acquired in order to alleviate the 1940 situation, described at the beginning of this article ; for otherwise, it would not have been possible for the Home and Empire carriers to continue operating. The choice fell mainly on Douglas and Lockheed types.

It is clear that, still today, the call for American aircraft has not yet died down. A thinly disguised implication that more U. S. flying equipment might be purchased, was given by Lord Knollys in August, 1946, when he stated that no British trans-Atlantic machine up to the standard of the Lockheed "Constellation" would be available until the appearance of the Brabazon I or Saunders-Roe S. 45. But today there is a firmer demand in Britain for U. S. types ; to quote from the press : "The acquisition of more American landplanes (BOAC already flies "Constellations" — Ed.) for use on both our trans-Atlantic and Empire routes would enable us to operate those services efficiently and economically. It would be a temporary blow to the prestige of the British aircraft industry, which, however, may otherwise be lowered by attempts to operate our external long-distance services with unsuitable types of British planes."

But a procedure of this kind would be contrary to the Government's economy programme, and not only be unfavourable to the British aircraft industry, but also to the Treasury. It would not be living up to the policy of "British aircraft flying the world's air lanes, offering British services." But purchasing in dollar countries ? Exports to dollar areas could only be increased by one percent per quarter-year during 1946, and, according to Sir Stafford Cripps, the British balance of payments will be busy with the dollar problem for the next fifty years.

Clearly, the complex of air transport and flying equipment bears less heavily on finance politics than shipping does. Relatively small sums are involved in flying equipment. But if a man has no money at all, the result is basically the same whether he be asked to produce one pound sterling, or one million pounds sterling.

IV

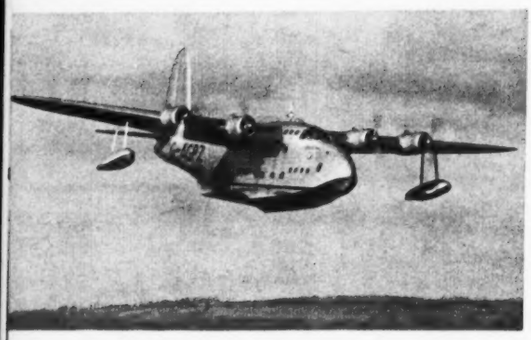
To build—as fast as possible and as many as possible ? This way out, which would seem to be the most logical, has its economic drawbacks. If state and industry today put every means at their disposal (which are by no means inexhaustible, and are also urgently needed for other causes) for a forced construction of a fleet of big airliners, it could very well happen that, once ready for production, thse aircraft be obsolete. For gas turbines, high-altitude aerodynes, and many other projects are today no longer to be classed among Wellsian dreams.

The crisis in British aviation dates back further than yesterday. Its re-organisation by amalgamation of Imperial Airways and British Airways was decided on already before the war. Imperial Airways was found to have plenty of cash in hand, but, already then, a shortage of aircraft was manifest. The companies

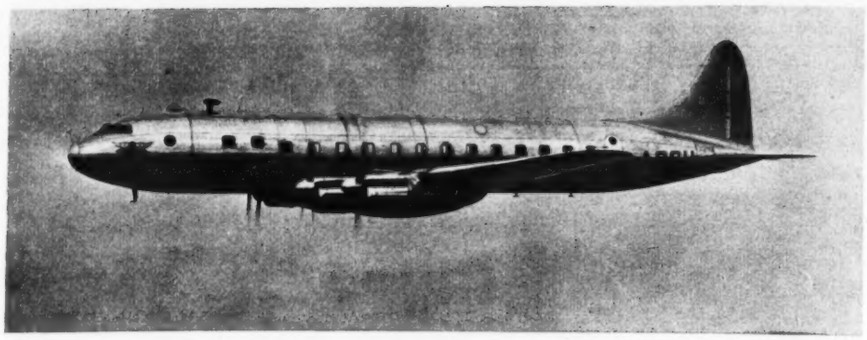
1946 : Handley Page "Halton", civil version of the "Halifax". Every passenger his own bombardier ...

1944-1947 : Avro "York", a wartime stop-gap.

CONCORDIA shown here as a ten
seater with all seats facing aft
CUNLIFFE-OWEN AIRCRAFT LTD
THE AIRPORT, SOUTHAMPTON, ENGLAND



1946 : Short " Sandringham ", new member of the trusty Short " Empire " family of flying-boats.



1947 ? : Avro " Tudor II ", like its sister " Tudor I ", a worry for the moment.

were transformed and nationalised ; the leading executives were dismissed and replaced by new men.

In the summer of 1943 Viscount Knollys, formerly Governor of the Bermudas, was called to head the new nationalised and unified BOAC. The re-organisation was more or less completed by spring, 1944, when Lord Knollys made his promise of jet-propelled flying-wing aircraft types for soon after the war. He was assisted by Brigadier-General A. C. Critchley as Director-General, and by Major J. R. McCrindle as Deputy Director-General. As a Member of the Boards of Directors of Barclays Bank and several insurance companies, Lord Knollys had made a name for himself as an expert administrator. Critchley, who for some time held the rank of Air Commodore, had been devoting most of his energy to greyhound racing, a business which never gave him cause for regret. Major McCrindle, who had been responsible for the rapid development of British Airways, was the only professional airman of the three. Critchley left BOAC some time ago to start Skyways Ltd., the charter airline ; and now, Lord Knollys has also announced his resignation for June 30th, 1947.

V

The top management of British aviation has again been subjected to changes. In the House of Commons on April 2nd, the Parliamentary Secretary to the Ministry of Civil Aviation, G. S. Lindgren, announced the new list of directors of BOAC and BEAC. It would be an exaggeration to refer to a landslide, but, on the whole, the impression is given that chiefly expert experience has been considered in the new selection.

Sir Harold Hartley, Member of the Board of Directors of BOAC since 1945, and also Chairman of BEAC since its formation last August, takes over the reins from Lord Knollys as Chairman of BOAC. His successor to the chairmanship of BEAC is Gerard D'Erlanger, who has been on the BOAC Board since 1940, and Managing-Director of BEAC since last August.

Both appointments deserve approval. Sir Harold Hartley was amongst those who built up Railway Air Services, of which he was Chairman from 1934 to 1945. Gerard D'Erlanger, a Member of the Board of British Airways from 1935 to 1940, was commandant of Air Transport Auxiliary, the civilian unit which ferried new aircraft from the factories to RAF bases, and is thus well acquainted with the field of flying equipment, an item of no little importance to the new organisation.

As for the new Managing-Directors, these posts are also competently filled : Whitney Willard Straight, who, though only 33, has been Deputy-Chairman of BEAC, has commanded RAF Middle East Transport Command, and was concerned before the war with domestic charter airlines, has been appointed Managing-Director (Chief Executive) of BOAC. Major McCrindle remains in BOAC, but changes his post from Deputy Director-General to Managing-Director (External Affairs). The new Managing Director of BEAC is J. V. Wood, formerly Manager of BOAC's Eastern Division.

British aviation has not been short of financial means during recent years, and it will not go short in in the near future. Between 1940 and 1947, the Government paid £ 15,000,000 to its airline corporations to make up for their deficiency payments, and thus kept British commercial aircraft in the air. Besides this, subsidies were paid, which were necessitated when civil aviation became part of the war effort. For the 1947-1948 fiscal year, the British Civil Air Estimates total £ 32,599,500, over £ 1,000,000 more than last year. Of this sum, £ 5,000,000 go to BOAC, whose subsidy thus remains roughly the same ; £ 2,250,000 to BEAC, as compared with a mere £ 870,000 in 1946, because precisely this Corporation must make the greatest effort ; and only £ 250,000 (against £ 50,000) to BSAAC. The largest sub-heading is that for flying equipment : £ 9,000,000 ; though it is substantially smaller than the £ 15,000,000 allocated in 1946, which, nevertheless, does not seem to have been put to the best of purposes.

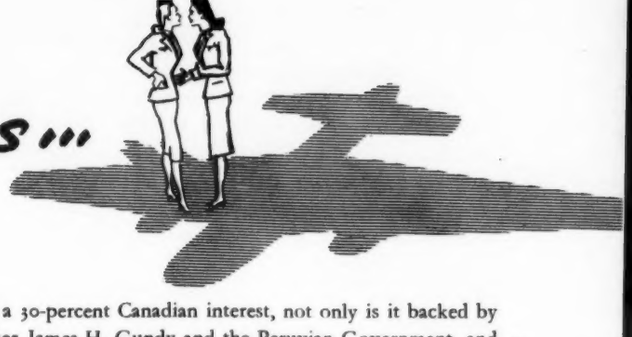
The way in which the new executives handle their responsibilities will be more or less decisive for the future of British aviation.

Apparently wide sections of the British public have no desire or intention to wait until 1951 to right matters, for which year Lord Nathan has promised that the first real post-war aircraft would be in service. There is a call in England for immediate action. Regarded in the light of the importance of the British Empire—and there is no denying that it is still mighty —the amounts necessary for this aviation programme are relatively insignificant. If no other way out can be found, then why not import more American flying equipment, if only as a temporary measure. Small considerations must be disregarded by men of action, this in order to provide British aviation with what it needs most : Aircraft ! *EEH/EH.*

1951 : Bristol 167 Brabazon I, the future " pièce de résistance " of British aviation.

1947-19.. : Handley Page " Hermes " (photo shows the " Hastings " military version) : hopeful for the near future.

The Air Hostess told us ...



" If you trust me... "

R. A. F. Transport Command is operating a special daily London—Moscow courier service for passengers and freight for the duration of the Moscow Conference of Foreign Ministers. This service is flown from London to the British Zone of Occupation in Germany, thence through a twenty-mile wide air corridor across the Russian Zone to Berlin, and onwards along a firmly prescribed route to Moscow. Our favourite hostess says she has a boy-friend flying on this route, and from him she got an interesting little scrap of " gen ".

R. A. F. Transport Command also makes a weekly courier flight from England to Berlin and Warsaw, and this flight is carried out by R. A. F. crews alone. But on the London-Moscow run atmospherical conditions seem to resemble those at Moscow's Aviation House, the scene of the Big Four's current pow-wow, about which H. I. Phillips wrote in the New York " Sun " :

If you trust me like I trust you,
We'll still be here in fifty-two.

It appears that before authorising R. A. F. Transport Command's London—Moscow shuttle service the Russians made one condition : the R. A. F. " Lancastrians " must carry a Russian navigator east of Berlin. *La confiance règne,* as you see. " No ", said the R. A. F., " our own navigators are perfectly qualified. " " Well ", replied the Russians, " then you can't fly over the Russian Zone or Soviet territory. " As a result, a Russian navigator and a Russian wireless operator are taken aboard in Berlin. Now, these rugged Russian airmen have a habit of flying by the seats of their pants and simultaneously scaring the latter article off their buddies in the R. A. F. They set little store by such new-fangled gadgets and ideas as navigating instruments and radio fixes. The navigator navigates by contact flying, the wireless operator uses his wireless merely to announce his arrival over certain control points. They make the British pilots let down to levels between zero and 150 feet and direct the machines by straightforward map-reading all the way to Moscow. With one eye on the map and the other on the ground below, the navigator gaily careens over slopes and steppes, rivers, towns, lakes and forests. All this while the British crew, apart from the perspiring pilot, play poker or twiddle their thumbs and hope for the best, and then some. Back in the cabin, the few official passengers are scared to the verge of extinction and think with longing of the lush, green meadows of England.

We fondly hope that when the official passengers finally step from the machine in one piece, shadows of their former selves, they are decided to forget all former political ambitions and concentrate on bringing about a civil aviation pact between the Western World and the Soviet Union, which would enable normal civil aviation relations to be established between East and West. But sadly we note a paradox : Politicians may become civil aviation-minded, whilst politics must be debated at Moscow's Aviation House.

PIA's International Hostesses.

In many respects, Peruvian International Airways—which piously abbreviates its name to " PIA "—is one of the most interesting recent developments in international commercial flying. Not only is it an international combine consisting of a 40-percent Peruvian, a 30-percent American and a 30-percent Canadian interest, not only is it backed by Canadian banker James H. Gundy and the Peruvian Government, and not only was it formed by aviation expert Clement Melville Keys, ex-executive with well-known Curtiss-Wright Corp., Sperry Gyroscope, North American Aviation, and Transcontinental & Western Air : it also distinguishes itself by the fact that it is headed by air transportation wizard Lieutenant-General Harold Lee George, war-time founder and Commander of Army Air Transport Command, who knows all the ropes in Washington. Within a few months, General George managed to secure working capital amounting to $ 4,000,000 and a Peruvian Government concession for a Peru—U. S. A.—Canada service ; he is expecting corresponding Canadian and American permits, has acquired a small fleet of five surplus Douglas DC-4 transports and ordered three new DC-6's, and hopes to inaugurate scheduled services on the Montreal—New York—Washington—Havana—Panama Canal Zone—Lima (Peru) route any day now. But that is not all.

PIA also provides unique service for its patrons. To quote from a recent company release : " ... For passengers, PIA will offer ... English-Spanish speaking flight hostesses and all other conveniences ... " Tsk, tsk ! Really ? Now, we should like to know what PIA's hostesses really do speak ? Spanish with an English inflection would rob that melodious language of its music, and English with a Spanish accent must be pretty unintelligible. " Meelk or veesky, yes-no ? " There is always the possibility, of course, that these hostesses will be recruited in the vicinity of San Antonio in Texas, where the tawny belles switch over from a Texan drawl to high-pitched Spanish staccato with the greatest of ease.

Anyway, PIA's polyglot hostesses once again emphasise the international character of aviation. They might accentuate it even more by changing into the national costumes of the countries over which their aircraft happen to fly. However, with increasing flying speeds they would be liable to spend most of their time in the dressing room, which would certainly have a detrimental effect on " all other conveniences ". Quite apart from that, the national costume angle would literally open new vistas : PIA might plan a service to Bali in the Dutch East Indies one day.

After You, Cecil...

Our favourite air hostess has a room-mate who has a boy-friend who has a job in the aircraft industry. He declares that one fine day during the war the Consolidated Vultee Aircraft Corporation in San Diego, California, received a letter from a free-lance inventor who submitted the following pearl to the company : " Gentlemen :—I have just finished a wonderful brake to be put on airplanes. This brake I invented can stop a plane that is doing 400 miles an hour in less than ten feet ... Now I am working on an invention to stop the pilot from going through the windshield ... " Apparently the company was not frightfully interested, because Uncle Sam had to win the war without this epoch-making contraption. But our hostess has been trying to trace that particular inventor ever since, because she believes that his brain-child would have a certain utility in air traffic.

She says that every time her aircraft lands she requests her passengers to " keep the seat belts fastened " and to " stay seated until the aircraft

stops ". Despite her admonitions, and especially in the newer tricycle airliners which stay horizontal on the ground, there is always a mad scramble in the gangway for hats and coats and umbrellas and handbags as soon as the aircraft touches down. Everybody gets in each other's way and knocked over—and in case a minor mishap should occur, the passengers' Coney Island behaviour might well magnify it into a major incident. Well, she says, if this fabulous brake were applied only once on a single aircraft in the presence of a newshound, with all the passengers landing like sardines on top of each other at the forward end of the cabin, the sensation-hungry press would raise such a fuss that passengers would stay seated for years after the occurrence and would have to be dug out of their seats with a spade.

This phenomenal brake might find a beneficial application also in the air. For example, it might serve to introduce somewhat more Latin forms of air courtesy over busy airports, and a four-engined " Constellation " might well be caught smiling priority to a Piper " Cub " with an accompanying " After you, Cecil ". All that would then remain to be done would be to invent a contraption allowing aircraft to bow from the waist.

P. A. B.

The Future Resumption of Italian Civil Aviation

BY GIUSEPPE BRUSASCA

Under-Secretary of State for Air in the Italian Defence Ministry.

The author was born on August 30th, 1900, in the Piedmontese village of Cantavenna Monferrato. In 1919 he left the Turin military academy with the rank of lieutenant in the artillery. After successful conclusion of studies in law and national economy, which accounts for his interest in politics — it was at the time of the March on Rome—and obtaining his lawyer's degree, he was elected to the Casale Monferrato town council ; in this post he led the opposition against the Fascist majority for four years. The ban on democracy led him to transfer to Milan, where he remained in contact with the clandestine liberation movement.

Fifteen years later, we find Brusasca, who had in the meantime become head of the Christian-Democratic Party in Northern Italy, as Vice-President of the Northern Italian Committee of Liberation and founder of the " Patria ", the partisan division formed of the liberators of his own province of Alessandria. On April 28th, 1945, he accompanied the English General Lidge, was parachuted into the battle zone, and took over the administration of the province. He joined the provisional parliament, was elected to the Constitutional Council in 1946, and a few days later was appointed Under-Secretary for Trade and Industry in the first government of the new Republic.

He was a member of the Italian delegation to the Paris Peace Conference as political adviser on Western frontier questions. In October, 1946, he was appointed by the third government, headed by de Gasperi, to join the Defence Ministry and therein to assume the duties formerly performed by the Air Minister.

In its effort to resume operations again, Italian civil aviation is at present in a delicate state of transition. The network over which services are shortly to be started must be considered as a rough outline of probable developments, conceived in the light of national requirements.

There is no sense in plunging into a definite exposé and formulating hypotheses, which could all be refuted by the events of tomorrow. The following account, therefore, is confined to a few principles which are today being observed in order to assure Italian commercial air transportation a satisfactory resumption of activities.

THE ITALIAN DOMESTIC AIR NETWORK

Carriers in which foreign interests participate

Linee Aeree Italiane (LAI), Rome.

Capital held 60 percent by Italians and 40 percent by Transcontinental & Western Air, Inc.

1. Rome-Florence-Turin.
2. Rome-Venice-Bolzano.
3. Rome-Bari-Brindisi.
4. Rome-Naples-Palermo-Catania.
5. Rome-Milan.
6. Rome-Palermo.
7. Rome-Cagliari.
8. Turin-Milan-Venice-Udine.

Aero Linee Italiane Internazionali (" Alitalia "), Rome.

Capital held 60 percent by Italians and 40 percent by British European Airways Corporation

1. Rome-Turin.
2. Rome-Trieste.
3. Rome-Catania.
4. Milan-Bari-Catania.
5. Turin-Milan-Venice-Trieste.
6. Milan-Genoa-Naples-Palermo.
7. Rome-Naples-Cagliari.
8. Cagliari-Milan.

Italian carriers

Aerso Tesso S. A., Florence :

1. Florence-Rome-Reggio-Calabria.
2. Bologna-Florence-Naples.
3. Florence-Bologna-Venice.
4. Florence-Bologna-Milan.
5. Florence-Bologna-Genoa.

Airone S. A., Cagliari :

1. Cagliari-Palermo.
2. Cagliari-Milan.
3. Cagliari-Naples.
4. Cagliari-Turin.
5. Rome-Alghero-Cagliari.

Avio Linee Italiane S. A. (ALI), Milan :

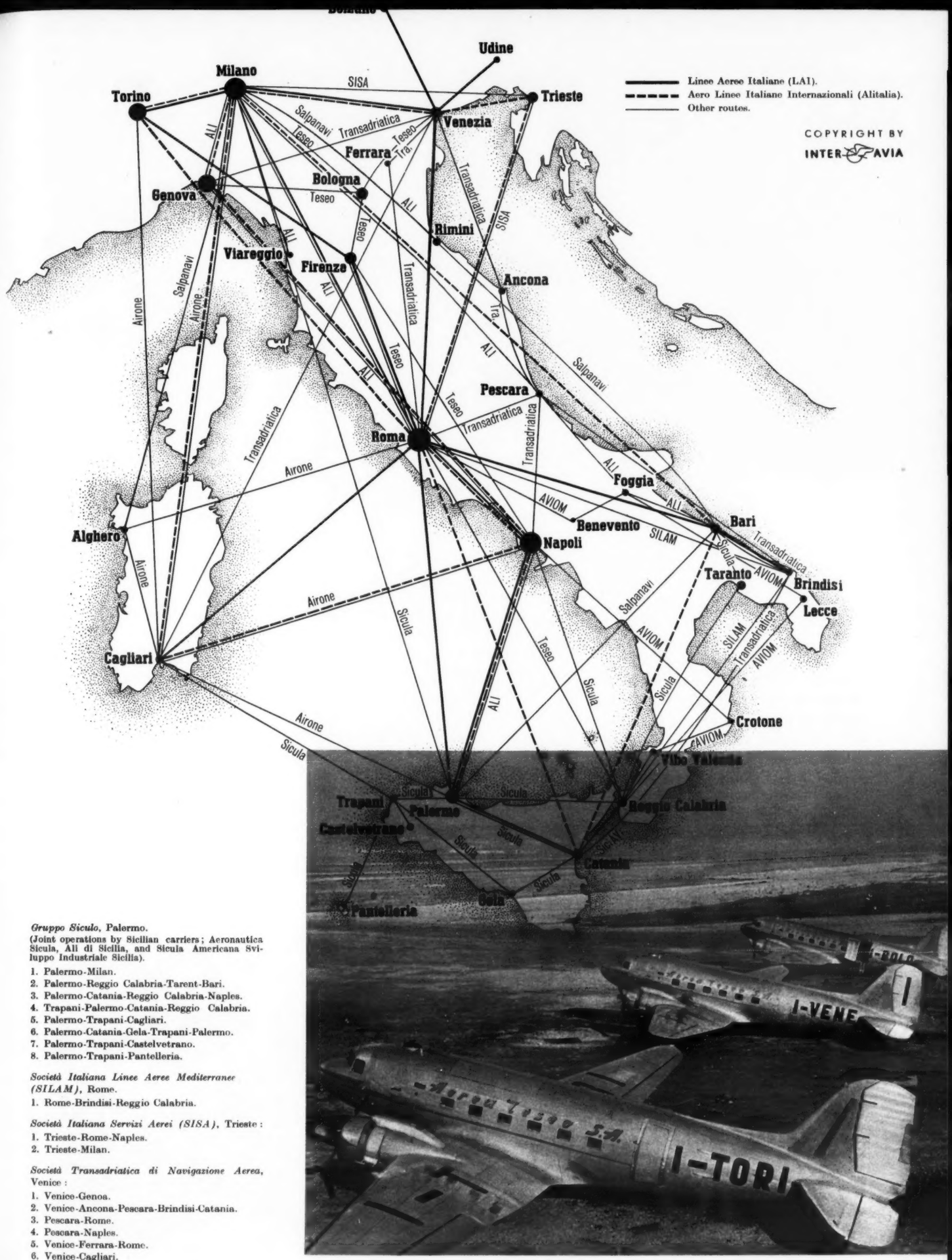
1. Milan - Pescara - Foggia - Bari - Brindisi.
2. Milan-Genoa-Naples-Palermo.
3. Milan-Rome.
4. Milan-Rimini (seasonal).
5. Milan-Viareggio (seasonal).

Aviorimesse Volte Industriali Opere Metalliche S. A. (AVIOM), Rome :

1. Rome - Benevent - Foggia - Lecce Reggio Calabria-Catania.
2. Reggio Calabria-Vibo Valentia-Crotone-Naples.

Salpanavi S. A., Milan :

1. Milan-Rimini-Bari-Palermo.
2. Milan-Alghero.



Gruppo Siculo, Palermo.
(Joint operations by Sicilian carriers; Aeronautica Sicula, Ali di Sicilia, and Sicula Americana Sviluppo Industriale Sicilia).

1. Palermo-Milan.
2. Palermo-Reggio Calabria-Tarent-Bari.
3. Palermo-Catania-Reggio Calabria-Naples.
4. Trapani-Palermo-Catania-Reggio Calabria.
5. Palermo-Trapani-Cagliari.
6. Palermo-Catania-Gela-Trapani-Palermo.
7. Palermo-Trapani-Castelvetrano.
8. Palermo-Trapani-Pantelleria.

Società Italiana Linee Aeree Mediterranee (SILAM), Rome.

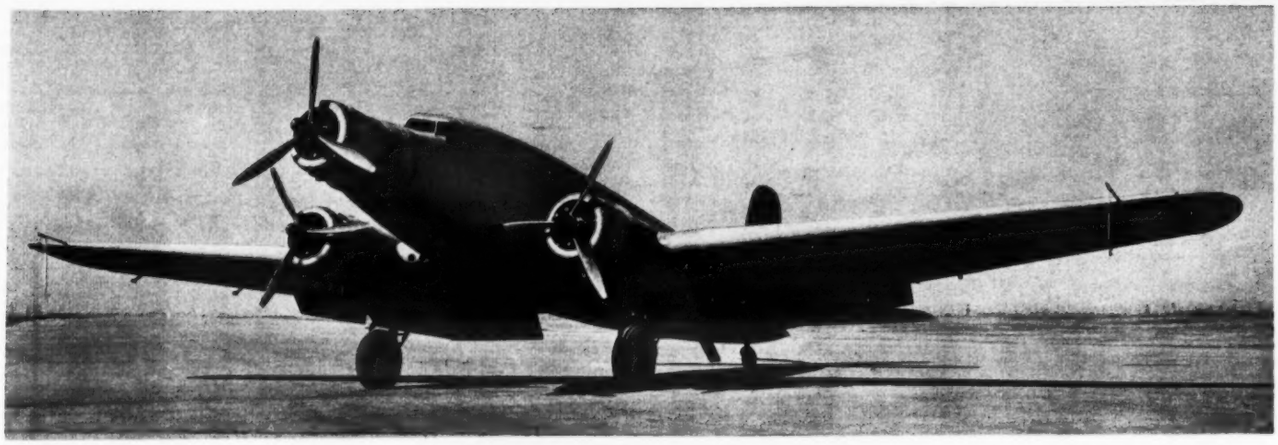
1. Rome-Brindisi-Reggio Calabria.

Società Italiana Servizi Aerei (SISA), Trieste:

1. Trieste-Rome-Naples.
2. Trieste-Milan.

Società Transadriatica di Navigazione Aerea, Venice:

1. Venice-Genoa.
2. Venice-Ancona-Pescara-Brindisi-Catania.
3. Pescara-Rome.
4. Pescara-Naples.
5. Venice-Ferrara-Rome.
6. Venice-Cagliari.



The *Fiat G. 212* three-engined commercial transport for 24 to 30 passengers was first flown last January ; six units have been ordered by Avio Linee Italiane (ALI), the airline subsidiary of the Fiat concern. Over twenty improved versions of the Fiat G. 12 (an aircraft similar to this one, but built in 1940) are being produced for ALI, Airone, and other Italian carriers.

The possibilities of a reconstruction of Italian civil aviation lie in two separate fields : domestic services and international services.

Domestic services

The development of aviation, which is now clear of the experimental stage and is about to play an important rôle in the economy of all countries, shows clearly that it can prove to be a source of profit also on internal routes. Moreover, in the particular case of Italy, it is evident that civil aviation offers enormous advantages as a supplement to the surface transport system, in part destroyed or still suffering from the vicissitudes of war. * In view of the present state of affairs this favourable conjuncture ties with the situation which prevailed in Italy already before the military events.

Already in the past, many possibilities existed in Italy of exploiting the advantage of air transportation over surface carriage : the geographical configuration of the peninsula, with its long extension towards Sicily ; the slowness of surface transport systems, except along certain main routes. Meanwhile, however, they were not sufficiently appreciated—though certain persons in the branch were quick to recognise them—and were obscured by the expansionist projects which tended to concentrate national efforts on a programme of pure political penetration.

It will be recalled that the services operated by Italian airline companies up to the eve of the last war, strove to meet the requirements of international traffic rather than those of home communications.

Just how few autonomous domestic services there were before the war is quickly discernible from a 1939 Italian air time-table. In contrast, there was an abundance of international or colonial leg routes, that simultaneously provided connections between a number of Italian towns. It will therefore be readily understood that the hitherto neglected development of a domestic air system, independent of international operations, now comes to the fore.

Since the war a great deal of initiative has been shown in the field of domestic air transportation, and it was no easy task to co-ordinate the projects submitted by the numerous aspirant carriers. Though the Italian government is giving every chance to private enterprise, it is keeping well in mind the necessity of careful route co-ordination in order that a unitarianized network should ensue. The map on the preceding page shows the routes comprising the new Italian air network, a product of long and tedious studies.

The future traffic volume will demonstrate whether this network is conceived in the best manner to suit national requirements. At all events, it may be affirmed that it will present none of those shortcomings characteristic of pre-war domestic air service, which, according to those who studied the question, were the following :

a) Almost complete lack of domestic routes south of Rome ;

b) Lack of direct connections between northern and southern Italy ; only one central junction, Rome, whence radiated the majority of routes. Consequently, in order to fly from one end of the peninsula to the other, it was necessary to go via two international routes which met in Rome, with the inherent disadvantages : difficulty of obtaining seats on aircraft flying international routes ;

* In 1943 the Italian State railways possessed over 7,900 passenger coaches ; today, there are only about 1,500, of which, of course, only a fraction are allotted to express services which would be for the airlines to supplement. And the express train requires a full 18 hours for the Milan-Rome route, about 350 miles. (Ed.).

An Italian four-engined commercial transport : The *SIAI-Marchetti S. M. 45* (Described in " Interavia ", Vol. I, No. 2, May, 1946).

schedules on such routes were not suited to inland requirements ; etc. ;

e) Lack of services enabling trips to be made within twenty-four hours between numerous localities which were otherwise closely linked by mutual industrial interests.

As regards ground organisation, a good number of Italian airfields have recently been returned to the jurisdiction of Italian aviation authorities. In future, a gradual effort will be made to eliminate to as great an extent as possible still another serious inconvenience : it has heretofore frequently occurred that it was impossible to establish suitable connections between two routes, although both passed through the same locality, because one was flown with seaplanes and the other with landplanes, and the landplane facility was situated at too great a distance from the marine base.

There is no doubt that passengers will be satisfied with the flying equipment, even if it is momentarily necessary to rely on certain stop-gap types, which is a pre-war characteristic prevailing today in every airfaring country. Italy is determined to continue to uphold her airline tradition of comfort, security and prosperity.

Prewar Italian Network. — Routes planned on political and strategic considerations (apart from the " Empire Route " to Addis Ababa, connecting with the Ethiopian network, it is interesting to observe the short routes radiating from Tirana to Albania, the dense network around the Upper Adria and in the vicinity of Gibraltar). " All roads lead to Rome " : no provincial connections ; no domestic routes in Southern Italy.

International services

Italy's present situation, and the sincere democratic attitude of her government, have completely eliminated those expansionist ideas restricted solely to politics, which in the past influenced commercial aviation development not only in Italy, but in nearly all countries of the world. All the same, even if only viewed from an economic aspect, it is clear that Italy must necessarily secure herself an airline network capable of meeting her requirements, and this as soon as possible. The great number of Italian nationals resident in various parts of the world ; the friendly relations between Italy and many foreign countries, far way from her as regards distance, but very close in spirit ; her industrial links with so many European and American nations : all these factors will prove helpful to the renaissance of Italian overseas air transportation.

Plans are also being formulated in this field.

Although absent (but not of her own will) from the International Civil Aviation Conference in Chicago, which ended with the signature of regulatory agreements to govern interstate air transportation for many years to come, Italy is all the same determined to contribute towards the progress of world aviation. This determination is revealed today in her readiness to grant landing rights to foreign carriers wishing to establish intermediate or terminal stops on Italian territory.

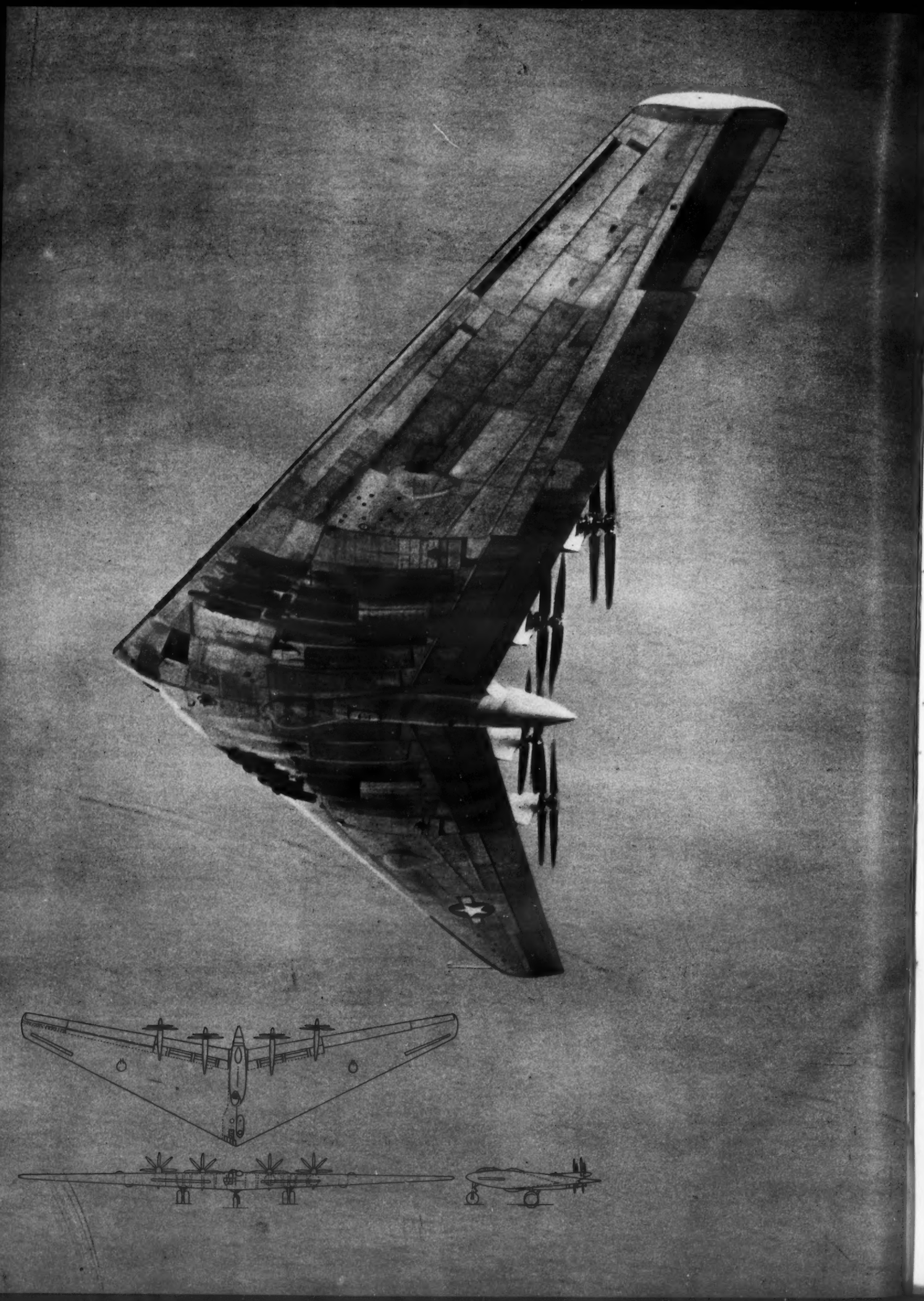
In principle, all foreign government requests for landing rights are approved, though on the normal condition that proper bilateral air agreements will be concluded as soon as the time comes. Relations of this nature have already been established with Argentina, Brazil, Colombia, France, Great Britain, Holland, Iran, Norway, Roumania, Spain, Sweden, the U. S. A. and Venezuela. A few countries, such as Ireland, Spain and Switzerland, have already submitted draft agreements, which are at present being examined.

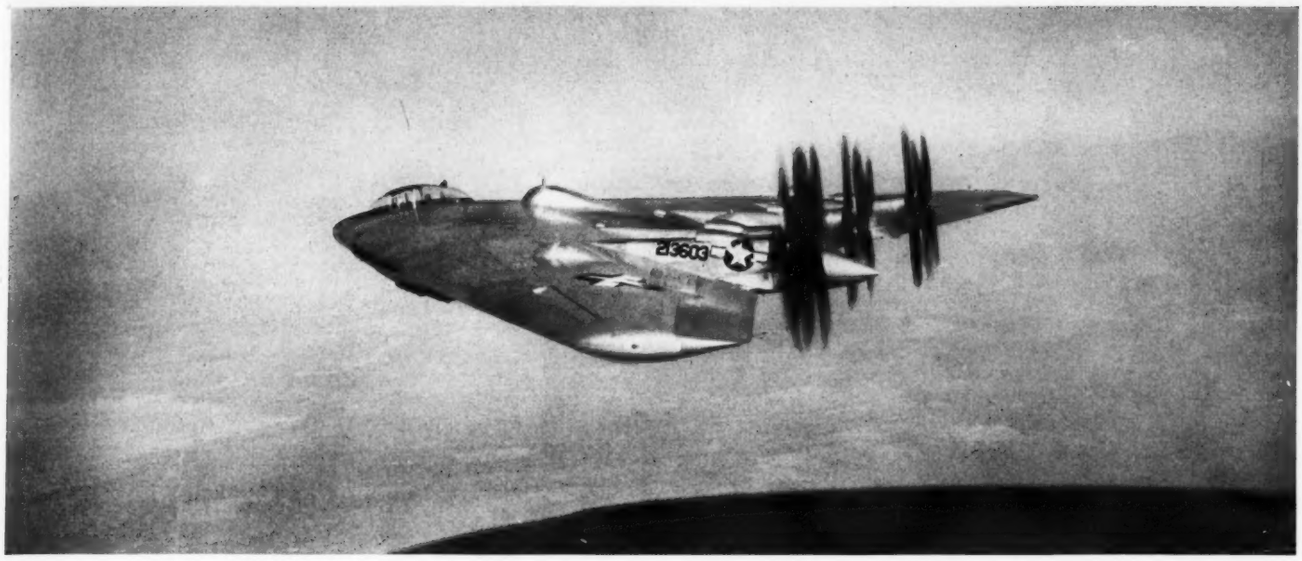
Italy's one desire in this respect is for circumstances which will free her of the reserve conditions contained in such provisional concessions, and will allow her to conclude bilateral air agreements with any country she wishes.

Giuseppe Brusasca

GIUSEPPE BRUSASCA
Sottosegretario di Stato
alla Difesa (Aeronautica)

The four-engined *Breda-Zappata BZ* 308, of which the prototype is now building, is designed for overseas services. It can be fitted to accommodate 55 passengers.





The Genesis of the Northrop XB-35

By A. M. Schwartz, Chief of Structures, Northrop Aircraft, Inc.

Passengers on the world airlines of the future may ride in huge Flying Wings which will gross 400,000 to 500,000 lbs. and be capable of spanning the United States in half a dozen hours, thrust through the sky by the power of giant jets.

Today these Flying Wings represent no particular problem to engineers. They can equal the finest ships in luxury. More than twice the size of the XB-35 Flying Wing bombers now being built by Northrop Aircraft, Inc., in Hawthorne, California, they can be equipped with promenade decks and clubrooms behind a glassed-in leading edge, and may be honeycombed with staterooms, lounges and dining rooms.

And since the Flying Wing design, as conceived by Northrop, is the closest approach yet made to a pure supporting surface, the Flying Wings are expected to be truly efficient airplanes, which will carry a given load a given distance cheaper than will any heavier-than-air craft yet conceived.

Simple in design, the Northrop Flying Wings are a complete departure from any other airplane now built. And since load in a Flying Wing aircraft is distributed span-wise instead of being concentrated in heavily reinforced places, the Flying Wing can effect great savings in structural weight with full safety.

Here is the story of the simple structure of the XB-35 Flying Wing bombers, largest tailless airplanes ever built and the forerunners, according to some aerodynamicists, of a new " family " of more efficient airplanes.

General:

The first Northrop Flying Wing airplane, the XB-35, is of unusual interest because it is not only unconventional in configuration, but is also one of the largest landplanes ever built. Largest previous " Flying Wing " built by the Northrop company had a gross weight of 12,000 lbs., as compared to the 162,000 lbs. design gross weight (208,000 lbs. overload gross weight) of the XB-35.

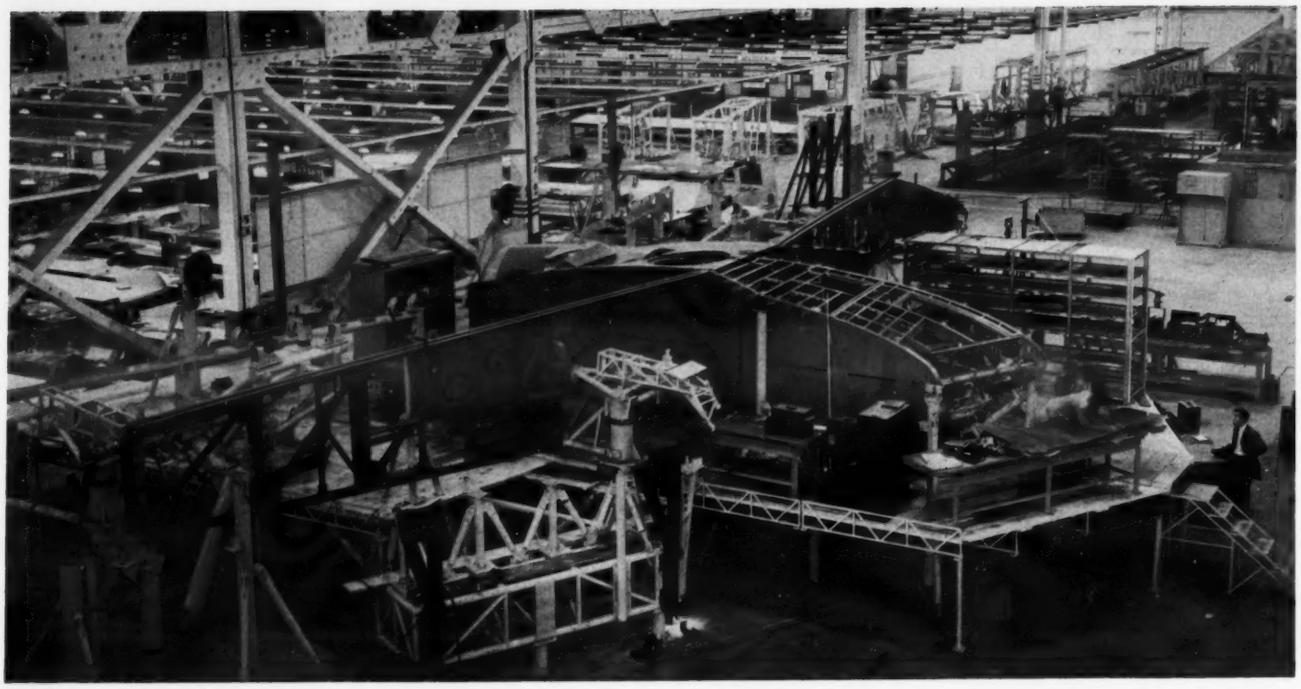
In general, the type of structure employed in the design of this airplane is not different from conventional practice, although such unusual configurations as sweptback wing, bomb-bay cutouts, and buried engine compartments required combinations of different types of structure. Semi-monocoque sheet stringer structure is used where possible, with a basic design criteria that the skin should not buckle up to 1.3 G acceleration.

The layout of the airplane is such as to produce a structural breakdown into several natural components. The major elements are the crew nacelle lying at the centre of the wing, the centre wing extending from the crew nacelle to a wing station 400 in. from the centre-line (just outboard of the outboard engine), and the outer wing extending outboard of the centre wing.

Outer Wing:

The outer wing is built around a framework comprising front and rear tension field spars, and ribs spaced approximately 4 ft. apart running parallel to the plane of symmetry. The bending material consists essentially of rolled hat-section stringers, three to four inches square, running in the general direction of the sweptback angle. 75ST aluminium alloy is used in all places where high strength is required.

Stress analysis of the wing was complicated because the ribs are not at right angles to the stringers or to the flexural axis. Particular care had to be taken to ascertain that the wing torque loads were properly combined with bending loads. Also wing cover shear panels formed by the stringers and ribs are not rectangular and,



Framework structure of the crew nacelle, with the attached main spars of the wing centre section.

therefore, had to be treated in a manner different from conventional methods.

The nose section of the outer wing is of interest because the outboard section includes a wing slot which is complicated by heat de-icing requirements. De-icing is accomplished by passing hot air through the slat and exhausting it into the wing proper through several hollow ribs which attach the slat to the wing. Slot doors at the entrance and exit of the slot are opened automatically by a pressure-sensitive device when the lift coefficient reaches a predetermined maximum value.

The leading edge of the outer wing inboard of the slot is also de-iced by heat. This is accomplished by passing air through chord-wise corrugations attached to the under surface of the nose skin. Air is supplied throughout the length of the nose by a duct running through the nose formers.

Centre Wing:

The centre wing structure is composed essentially of a nose section which includes the main or front spar, and a rear section composed of an upper wing skin and the rear spar. Massive ribs run between the front and rear spars, dividing the section of the wing aft of the main spar into bays, four of which carry bombs, one into which the landing gear retracts, and another in which the outboard engine is housed. The lower surface of this section of the wing, between the front and rear spar, is entirely open except for moving doors.

The spars are primarily trussed, principally to allow openings for the buried engine installations and for ready access to power plant accessories located in the nose section. These spars are attached to the outer wing spars by means of permanent bolted joints. The front spar changes direction at the junction with the outer wing because of space requirements. This change in angle of the spar cap produces a large chord-wise load component, which is carried by a major structural rib located at the spar junction.

The attachments of the centre wing to the outer wing and the crew nacelle sections are permanent joints. The airplane is so large that it was considered impractical to have replaceable units such as the centre or outer wing. Consequently, the wing joints were not designed for interchangeability or field disengagement. In the fabricating process, however, the primary airplane components are made on separate jigs and then assembled on a final fixture which holds all parts in proper position in relation to one another. Wing joints are then bolted and riveted together as an integral structure.

The nose section of the centre wing is a torque-stiff structure which transmits approximately 90 percent of the wing torque carried by the centre wing. Differential bending of the rear spar and the nose section accounts for the remaining ten percent.

In general, the nose section structure consists of the front spar, the leading edge spar (located at about ten percent chord), several massive leading edge ribs running between the front and leading edge spars, and a stiffened skin covering.

The leading edge spar provides a shear carrying element through the leading edge air duct which supplies air to the engine installation. Streamlined diagonals are used in this spar to minimise obstruction to the air coming through the duct.

The inboard engine is mounted between two ribs in the nose section just ouboard of the crew nacelle. Quick detachable fittings are provided so that it may be removed through a doorway in the lower surface of the wing when servicing is necessary. The door is securely bolted to the lower surface of the wing with a number of fittings in order that it may act as an integral part of the nose structure. Removal of door and engine, and re-installation, may be accomplished in approximately two hours.

The propeller shaft from the inboard engine passes through a hollow rib running between the front and rear spar, and terminates at a gear box attached to the aft end of the propeller housing. This shaft is divided into three segments having splined couplings at each joint. The spline couplings are fitted together loosely enough to provide sufficient angular displacement to take care of deflections of the wing structure.

A compartment known as the plenum chamber, which carries all of the engine accessories, such as turbo-superchargers, intercoolers, etc., is located in the nose section between the inboard and outboard engines. This entire chamber is pressurised by air coming through the leading edge duct. The four turbo-superchargers and the bank of

intercoolers draw air at approximately ram pressure from this chamber. Several of the nose section ribs running between the front spar and the leading edge spar are used as ducts to carry hot air from the heat exchangers to the leading edge which is to be heated to prevent ice formation. These ribs are made as box structures so as to act as ducts. Because of the high temperature, they are made of stainless steel. The plenum chamber is serviced through a large opening in the bottom of the wing, which is normally closed by a stressed door.

The outboard engine is installed between the front and rear spar just inboard of the junction of the centre and outer wing. A non-stressed door is located beneath the engine, which allows removal of the latter for servicing. A propeller shaft consisting of two segments extends from the engine to a gear box located at the aft end of the outboard propeller housing. The segments of this shaft are interchangeable with the inboard engine propeller shaft.

The bomb-bay doors located on the bottom of the wing between the front and rear spars operate similarly to the old-fashioned roller-top desk door. The door itself consists of a thin stainless steel sheet to which chord-wise hat-section stringers are spotwelded approximately 3 in. apart. Anti-friction rollers are attached to the ends of each stiffener on the door by means of a shaft which telescopes into the end of the stringers. These rollers run in tracks attached to the sides of the bottom rib caps. The telescoping feature was necessary to allow for span-wise expansion and contraction of the bomb-bay due to the flexure of the wing. The door is opened by winding it on a drum located just forward of the rear spar.

The bomb-bay ribs were designed as box-beams primarily to reduce the side deflections caused by the bombs which are slung to the sides of the ribs. The ribs are also equipped with fittings to allow installation of auxiliary gasoline tanks, which are used when the airplane is required to fly a particularly long distance. These tanks are arranged so that they may be jettisoned in case of an emergency. In order to prevent possible jamming of the tanks during the time they are dropped, a pivot is located at the rear of the tank, which acts as a guide as the tank falls from its compartment.

The stress analysis of the centre wing was rather complex because of the interaction of the torque-carrying nose section, the rear spar and the bomb-bay ribs. Enough assumptions were made to reduce the unknown inter-reactions to eight. The calculations were then carried out on a unit basis so that numerous loading conditions could be handled in a fairly simple manner. The solution of the unit load equations made it possible to determine how much of the torque was carried by differential bending of the nose section and rear spar.

Crew Nacelle:

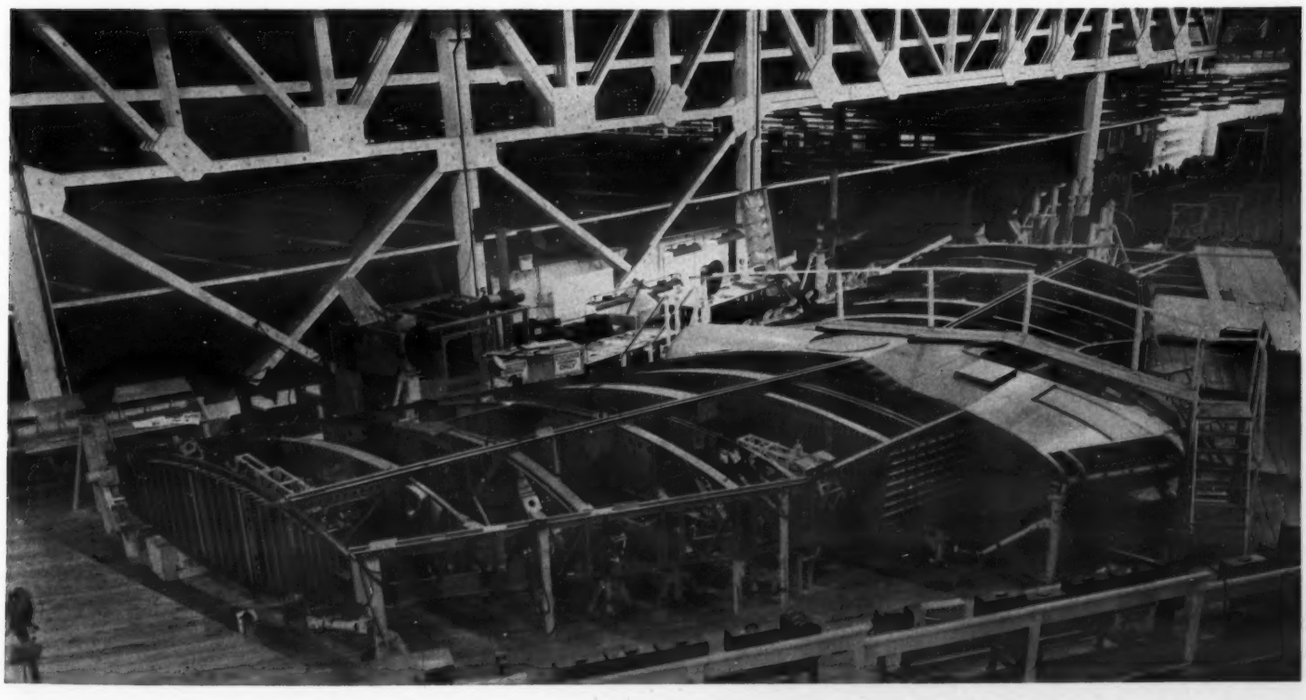
The crew nacelle consists of two sections: one forward of the front spar, known as the pilot's compartment; and the second aft of the spar, known as the crew compartment. Easy access from one compartment to the other is provided by a doorway located in the front spar. Since this doorway is never hermetically sealed, both compartments have a common internal pressure.

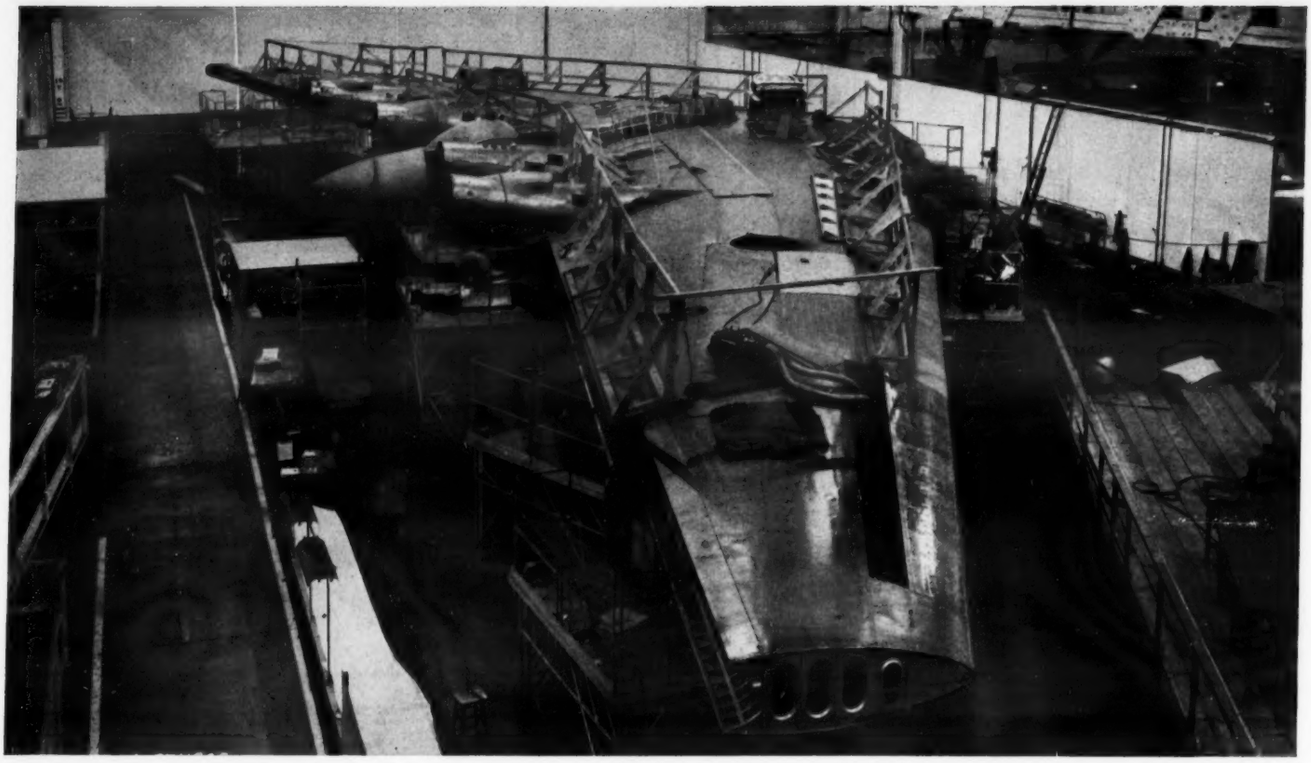
The pilots' compartment is occupied by the pilot, co-pilot, bombardier, navigator, gunner, engineer and radio-operator. The pilot is elevated sufficiently to allow his head to project above the wing contour, enabling him to have excellent visibility forward and to all sides. A transparent bubble canopy extends over his head and far enough to the rear to enclose the gunner who is also seated in an elevated position.

The co-pilot sits to the right of the pilot, but at a lower level, windows in the leading edge providing visibility forward and upward. The large window just above and forward of the co-pilot, which affords his major vision, is a sheet of methyl methracrylate plastic approximately 2 ft. wide, 5 ft. long and $^{7}/_{8}$ in. thick. The great thickness is necessary to carry the internal pressure.

The most interesting feature regarding the design of the crew nacelle structure is that no effort was made to design the cabin as a pressure cylinder such that the primary loads would be carried in tension. In the case of the XB-35 all structural members of the crew nacelle carry the internal pressure primarily by bending. Although it was anticipated at the outset that the structure might prove ex-

Wing centre section with partly covered crew nacelle





The XB-35 approaches its final form.

ceedingly heavy, it was found in the final analysis that cabin pressuration was accomplished at a not unduly high cost in weight. It is estimated that the extra weight involved in carrying the 7.5 psi working pressure (15 psi ultimate pressure) amounted to approximately 600 to 700 lbs.

Briefly, the structure of the pilots' compartment is as follows. Frames encircling the compartment are spaced at approximately 11 in. intervals in the fore and aft direction. The top and bottom members of the frames tie into the centre wing stringers and serve as wing bending material across the centre-line of the airplane. The

Final assembly of three of the fifteen XB-35 bombers building at Northrop's.

leading edge spar, mentioned in the discussion of the centre wing, passes through the cabin just aft of the pilots' seats. It is designed as an open truss in this area to allow freedom of movement in the pilots' compartment. An additional truss on the centre-line of the airplane runs from the front spar to the leading-edge spar. This truss serves as a tie between the upper and lower frame members to aid in carrying the cabin internal pressure. It also supports the vertical load component applied by each wing stringer as it changes direction (because of wing taper) when passing across the airplane centre-line. In addition the centre-line truss carries the loads from the nose-wheel strut which is attached to its forward end.

The crew compartment is designed to accommodate a complete relief crew. Double-deck bunks are built against each side wall, the upper bunk being arranged to fold up against the wall so that the lower bunk may be used as a seat or lounge.

Future Flying Wings:

Actually it appears that very large Flying Wing type aircraft would have distinct advantages over medium size airliners. Considerable saving in structural weight was realised in the design of the XB-35 because of the spanwise distribution in which much of the load is largely airborne. With the greater freedom of load distribution possible with a larger airplane, even further savings in structural weight may be achieved.

The future of the very large all-wing commercial aircraft is also enhanced by the fact that great sacrifices in structural efficiency, resulting from military requirements, are eliminated. For example, the removal of the lower skin of the XB-35 wing in the bomb-bay area to allow bombs to be dropped constituted a severe structural sacrifice, costly both from the standpoint of weight and structural stiffness. A passenger or freight carrying airplane could be loaded through relatively small openings. In the latter case, a conveyer might be conveniently used to load freight through hatches in the wing ; and if bulky commodities have to be handled, stressed doors with quickly-operated locks could be fitted.

Jet propulsion seems to promise great advantages. The exceptionally low drag of the all-wing airplane permits jet propulsion to compete economically with the conventional reciprocating engine driven propeller type of propulsion. Whereas the present reciprocating power plant requires a large volume of accessories, which are located in the nose of the XB-35 wing, the jet installation would eliminate all such extra equipment. The major position of the nose section of the wing could therefore be used for a passenger compartment.

In order to provide a glassed-in promenade or club room in the leading edge, shear stiffness of the nose skin structure could be maintained by trussing with a large mesh geodetic type structure (windows being located between members of the truss), or by providing an open trussed beam just aft of the leading edge to replace the nose section made ineffective by window openings. This beam would not seriously obstruct passenger movement or vision.

A considerable saving in weight of the future all-wing airplane might possibly be achieved by eliminating the landing gear and designing the lower surface of the wing as a hull so that the aircraft could be used as a flying-boat. When it is realised that the landing gear of the XB-35 weighs around 10,000 lbs. (not counting structural provisions for attachment), the advantage of its elimination become apparent. A further benefit would be the removal of retracting complications involving extensive hydraulic or electric equipment, as well as elimination of landing gear doors. At the present time, of course, technical difficulties prevent the lower wing surface from being used as a hull because of the improper hydrodynamic shape, though it does not seem improbable that this problem might be solved.

Société Nationale Aéro-Centre NC 2001 Helicopter

By M. R. Dorand, Chief Engineer, S.N.C.A. du Centre

In 1922, at the age of 24, *René Dorand* obtained his diploma from the Ecole Supérieure d'Electricité, and submitted his first invention for patenting during the same year. In 1924, he joined the Louis Bréguet aircraft firm, where he quickly obtained success in his work on rotary-wing aircraft : his Bréguet-Dorand experimental helicopter broke all world records in 1935 and 1939, and still today holds the national records for its category. As Chief Engineer of Société Française de Gyroplane (a Bréguet division), Dorand managed to save his company's data and archives from being seized by the Germans in June, 1940. Together with Louis Bréguet, he worked on new helicopter plans between 1941 and 1944, first in Anglet (B.-Pyr.) and later in Versailles. Following the liberation of France Dorand became Chief Engineer of S.N.C.A. and founded a special helicopter division in autumn, 1945.

With the *Bréguet-Dorand* experimental helicopter, and Maurice Claisse at the controls, France secured several world records for rotary wing types in the years from 1935 to 1936. Propelled by two co-axial contra-rotating rotors of 53 ft. ½ in. in diameter, and a 295 to 345-H.P. Hispano 9Q air-cooled engine, this aircraft passed every test prescribed by the French Air Ministry and simultaneously achieved the following internationally-recognised results :

22.9.1936 : Altitude record of 158 m (former record, 20 m).

22.11.1936 : Endurance record of 62 min. (formerly, 8 min 45 sec).

(A year later a German Focke Fw 61 helicopter broke the world endurance record, staying in the air for 65 min, whilst the Americans achieved an identical result on April 15th, 1941, with a Sikorsky VS 300.) On the occasion of the endurance record, the Bréguet-Dorand beat on

24.11.1936 : World distance record in a closed circuit, 44 km, against 1.07 km.

Beside these, it achieved other successes. In 1935 already, in the presence of the competent authorities, it attained a speed of 67 m.p.h., remarkably high for that time, at the firm's test base in

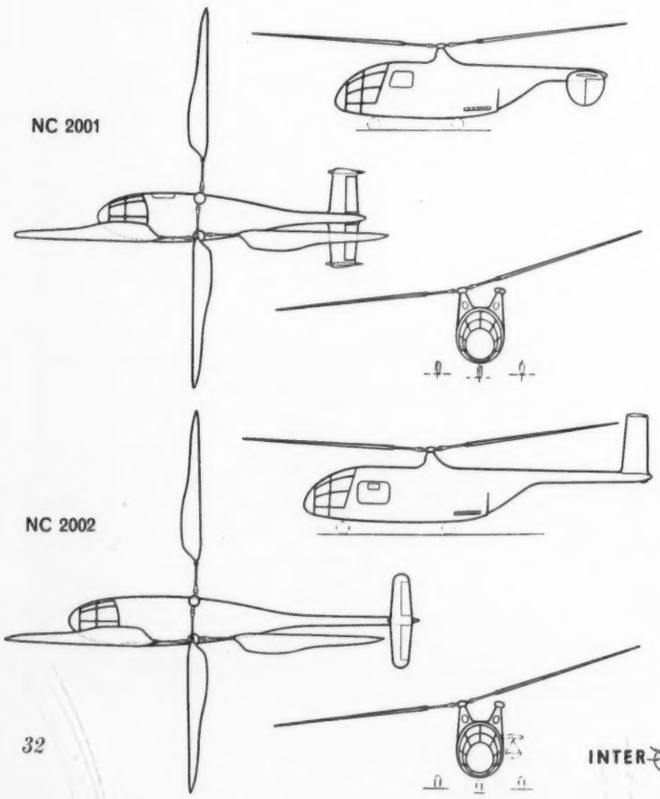
Bréguet-Dorand experimental helicopter during its endurance record flight on November 24th, 1936

Villacoublay, when it also managed to hover for 10 min 15 sec and lift 1,100 lbs. of sandbags. In the course of these tests, notably during glides with the engine cut out, the automatic pitch change of the rotor blades proved its effectiveness.

The data collected during the course of these successful experiments with the Bréguet-Dorand helicopter served as basis for the design of numerous other rotary-wing aircraft. But, at the outbreak of war, the majority of these were still building or else in the development stage. It is largely thanks to Colonel Garry that French helicopter designing could be reanimated after the liberation.[1]

The French national aircraft manufacturing concerns began to take an ever keener interest in rotary wing types. Certain concerns engaged the services of foreign experts (Germans and Austrians), whilst others, such as Aéro-Centre, preferred to rely upon their own national engineers and designers.

[1] Cf *ESPACES* No. 10.



One of the latest products of *S.N.C.A. du Centre* (Aéro-Centre) in the rotary-wing field is the *NC 2001 " L'Abeille "*, a single-engined helicopter which the firm began developing in summer, 1945, and of which the prototype was on show at last year's Paris Salon.

The design of the NC 2001 was based on a desire for a multi-purpose aircraft :

— *Feeder services*, point to point, based in the centre of a town ; one pilot ; 4 passengers ; 4 ½ hours' flying over 500 miles.

— *Ambulance services* over a decreased range of 220 miles, with one pilot, one attendant and two patients; from an accident scene to a hospital.

— *Mail carriage* over medium ranges of about 550 miles, with 4,440 lbs. of mail. The spacious cabin, approx. 88 cu. ft., permits fairly voluminous loads to be carried.

Thanks to the incorporation of dual controls, the NC 2001 can also serve for training purposes ; and by substitution of a slightly modified nose section (in which case it assumes the designation *NC 2002*), it may be used for rescue services at sea or in mountainous regions.

Construction :

The NC 2001 is a single-engined, all-metal helicopter driven by two intermeshing, two-blade rotors located on axes which are directed on an outwards slant. The common gearing of the axes permits autogyration of both rotors in a case of engine failure. The nose section is entirely transparent and contains the cockpit with two side-by-side seats and dual controls, whilst the rear fuselage forms a cabin for three passengers.

The aircraft is primarily composed of six assembly groups, thus providing simplicity of manufacture and permitting rapid replacement should the need arise.

1. Fuselage
2. Tail boom
3. Undercarriage
4. Power plant and gearings
5. Empennage
6. Flight controls

Fuselage :

The fuselage is divided into three parts by bulkheads, communication being provided by doors.

As stated above, the nose section comprises the cockpit with two side-by-side seats and complete dual controls. For unobstructed visibility on all sides, the two communication doors in the bulkheads are made transparent to as great a degree as possible. The centre passenger seat swivels in order to facilitate access to the rear luggage compartment and to the mechanical organs needing attention during flight.

The power plant, mounted on shock absorbers, is housed in a special rear compartment and closed off by a fire-proof bulkhead.

On the ground, detachable lateral cowlings permit easy access to the engine as well as simple and rapid dismounting. A blower, aided by the exhaust action, supplies the necessary cooling air.

The fuselage, of light-alloy monocoque construction, divides into two halves. The front half comprises the cockpit, passenger cabin and the nose-wheel with its retraction mechanism.

The Plexiglas skin is supported by a welded steel-tube framework. The rear half is more or less the power station, containing the engine, cooling blowers and fuel tanks. The tail part merges into a cylindrical tail boom composed of two half-coques of stressed light

alloy ; its forward section supports the engine mounting and its rear section the retraction apparatus for the main landing wheels. The rear bulkhead connects the fuselage and tail boom.

Tail assembly :

To meet all possible requirements as regards control and stability, the prototype is experimentally provided with two tail-assembly versions, interchangeable at will. One of these consists of a fin, a tail plane and an elevator, the entire assembly being borne on a long boom so as to be outside the rotor downwash. The other arrangement comprises a twin fin and rudder unit, supported by a shorter tail boom and within the downwash area. The stabilizing surfaces of both versions are formed of AU4G-alloy half-coques ; all moveable surfaces are fabric-covered.

Undercarriage :

The wheels of the NC 2001's tricycle undercarriage can swivel through 360°, so that landings can be made without taking the wind direction into account. The relatively large track of the main wheels, and their equipment with brakes, permits landings to be effected on sloping or uneven ground ; for glide landings—as made with rotary-wing aircraft—the wheel-forks can be blocked.

Power plant and gearings :

The engine is to be a 493-H.P. Renault 12 S 00 twelve-cylinder in-line unit, located horizontally, with the power transmitted by a torque shaft.

The two contra-rotating rotors are driven through a freewheel gear ; the latter transmits the rotary motion via two shafts and two bevel gears to two further shafts which are parallel to the rotor axes. These drive the rotor axes proper via universal joints, housed in the two fuselage superstructures, and via double reduction gears (14 : 1). For cyclic blade-pitch adjustment, each axis is fitted with a swivelling gimbal ring.

In a case of engine failure, the free-wheel gear permits autogyration of the rotors, whereby the rotative speed immediately and automatically adapts itself to gliding flight conditions.

Should the gears become wedged as a result of a failure in the mechanical transmission, a quick disconnect releases the rotor axes to permit autogyration. This provides an additional safety factor, again making it possible to effect a glide landing. In every case

NC 2001 with retracted undercarriage

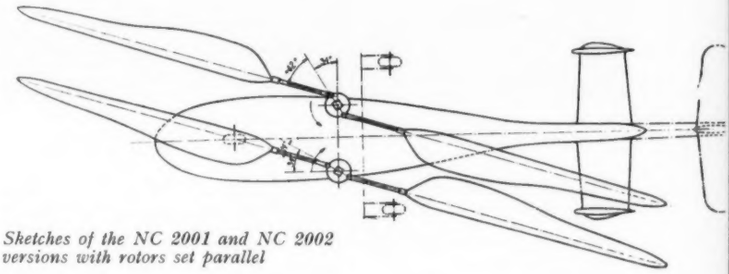
Undercarriage retraction mechanism of the NC 2001

the rotors' contra-rotation and cyclic pitch change remains, of course, effective.

An automatic coupling device, working on a centrifugal principle, sets the rotor in motion.

Rotors :

Each AU4G-alloy rotor blade consists mainly of a box formed by a U-extruded longitudinal girder (front section) with two rear



Sketches of the NC 2001 and NC 2002 versions with rotors set parallel

flanges connected to it. Two steel strips which support the leading edge simultaneously serve as balance-weights. The outer part of the blade is formed by two half-coques of light alloy.

The blade is set on a relatively long steel tube which bears the pitch-change pivot and makes an articulated joint with the hub (a construction method used for the first time) so that the blades can deflect perpendicularly to, as well as in, the rotor plane. Blade movements in the rotor plane are considerably restricted by two damping devices working on both rotors ; one of these copes with differential deflections and the other with simultaneous deflections.

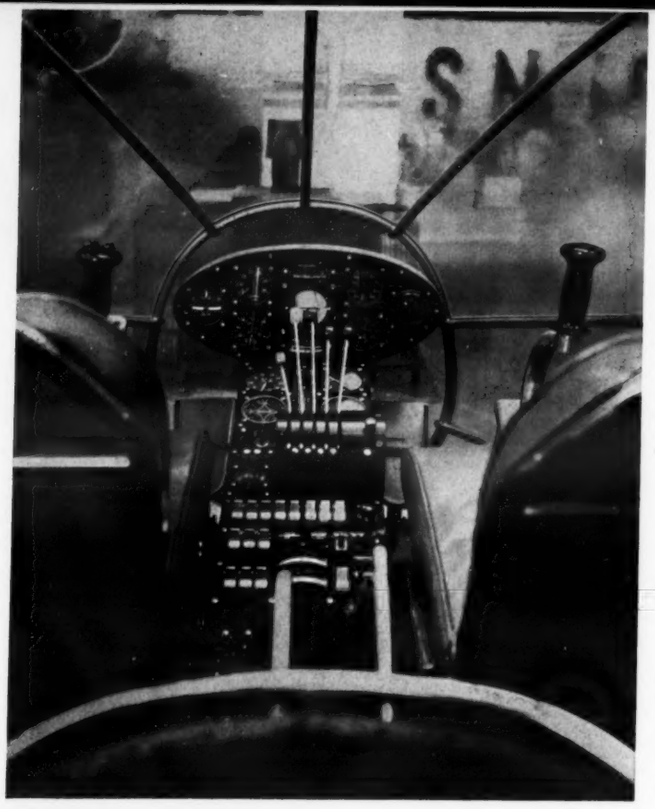
As the same damping device applies to both blades of each rotor, there is no need to fear the vibrations which generally occur in the case of unequally-regulated dampers for each blade.

The unavoidable slight vibrations of the blades in and perpendicular to the rotor plane have often led to considerable disturbances in the case of conventional blade attachments with ball-bearings in the hub. In the NC 2001, the rotor hubs contain rubber stops. This arrangement makes it possible to avoid the wear and tear which otherwise occurs as a result of centrifugal and blade-oscillation stresses. At the same time, it eliminates the high degree of friction prevailing in roller or needle bearings, which often hinders flight control and can lead to undesirable blade oscillations.

Special attention has been paid to the aerodynamic form of the blades. An exact study of the influences of tapering, chord variation and airfoil section—the airfoil is inherently stable at the blade roots and laminar at the tips—warrant the assumption that the rotors will enable very satisfactory results to be achieved, notably in high speed flight and climbing.

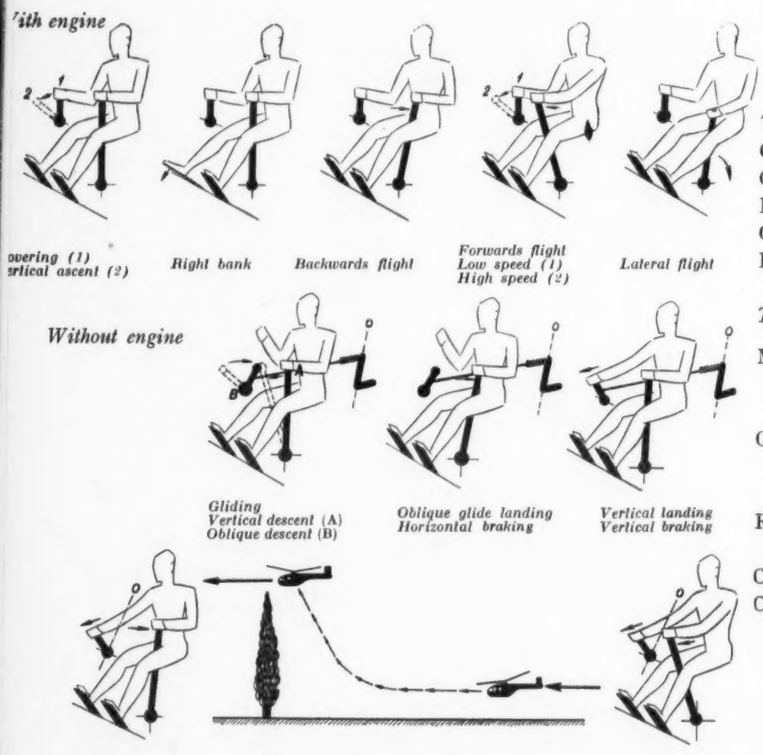
Flight Control :

Forwards, backwards, as well as sideways flying is accomplished in the usual way by cyclic pitch change of both rotors.



Cockpit fitted with dual controls

Ascent and descent is achieved by operation of a control lever (pulling and pushing), whereby an equal and simultaneous inclination of the gimbal rings and thus an adjustment of blade pitch in both rotors is produced.



Take-off with subsequent fast climb

For control of the aircraft, the pilot has a control lever at his left, a joystick, and foot-pedals for lateral guiding.

The function of the joystick is discernible from the sketches (direction in a horizontal plane). The control lever is solely for blade pitch change and thus for ascent and descent. With the engine on, pressure of this lever causes the helicopter to climb, whilst it checks the speed of descent when the engine is stopped. If the engine fails, the control lever is automatically brought back to neutral.

Banking is effected with the joystick, left and right movements resulting in corresponding variations of the positions of the two rotor discs. For safety reasons, the design provides that there shall always be sufficient clearance between the two rotors, no matter what variations of position are selected.

Finally, lateral control is accomplished with two foot pedals which effect different inclinations of the rotor blades, whilst a simultaneous and opposed longitudinal and lateral inclination of the virtual blade axes obviates parasitic influences of directional control on the other flight controls.

Although, as a result of the war, the French aircraft industry is still seriously short of raw materials and is still offset by the absence of intermediate processing firms and measuring instruments, it may safely be assumed that France will soon resume her prewar position as regards helicopter construction.

Specifications:

Dimensions	*NC 2001*	*NC 2002*
Rotor diameter	45 ft. 3 in.	45 ft. 3 in.
Maximum length with rotors set parallel	43 ft. 7⅝ in.	47 ft. 6¾ in.
Fuselage length	31 ft. 10 in.	41 ft. 2½ in.
Tail plane span	10 ft. 8⅜ in.	11 ft. 1⅞ in.
Undercarriage track	10 ft. ½ in.	10 ft. ½ in.
Wheel base	10 ft. ½ in.	10 ft. ½ in.

Shock strut play : fore, 10 in. ; rear, 15¾ in.

Operational uses of the NC 2001 : *Power plant*	As an ambulance with a range of 220 miles at a speed of 152 m.p.h. (3 occupants)	As a commercial transport with a range of 500 miles at a speed of 112 m.p.h. (5 occupants)
Renault 12 S 00 air-cooled twelve-cylinder in-line		
Take-off power	493 H.P.	
Climbing power	444 H.P. at 9,840 ft.	
Cruising power	365 H.P. at 9,840 ft.	
Fuel supply	37 Imp. gals.	110 Imp. gals.
Gross weight	5,070 lbs.	5,997 lbs.
Power loading	10.3 lb./H.P.	12.16 lb./H.P.
Test performance		
Maximum speed		
at sea level	155 m.p.h.	137 m.p.h.
at 10,500 ft.	174 m.p.h.	140 m.p.h.
Cruising speed		
at sea level	137 m.p.h.	103 m.p.h.
at 9,840 ft.	152 m.p.h.	112 m.p.h.
Rate of climb, vertically at maximum output	16.4 ft./sec.	7.38 ft./sec.
Ceiling in vertical ascent	13,120 ft.	9,840 ft.
Ceiling in oblique ascent	19,685 ft.	16,400 ft.

ALTITUDE RECORDS

By P. BERGER, D. Sc., Payerne, Switzerland

Introduction :

When sporting flying had attained a certain degree of development, one or more national aero clubs were formed in the majority of countries. Until the beginning of this century their activities were confined to balloon flying, and it was not until after the year 1900 that the first navigable airships were designed ; these mostly originated in France and Germany. Numerous problems of international character (record comparisons) began to arise. In order to achieve certain standardised methods of treating technical problems, to promote the development of sporting flying, and to avoid difficulties being experienced by crews landing on foreign territories, the various national aero clubs united to form a world organisation : the Fédération Aéronautique Internationale (FAI). Founded on October 14th, 1905, by Belgium, France, Germany, Great Britain, Italy, Spain, Switzerland and the U.S.A., the organisation's headquarters are in Paris.

The FAI is entirely independent of both commercial and military aviation. It is the only international sporting flying organisation with the authority to establish and apply regulations for the encouragement of aviation and the registration of records. It has worked out a very complete set of directing principles covering the staging of international events, the execution of record attempts, legal questions, etc., as well as the technical details in connection with distance and altitude measurement, chronometry, etc.

By definition, an aviation record is the best performance effected in accordance with special conditions determined by the FAI. They may be national, international or world records. Those in the two last-mentioned categories have to be carried out in accordance with norms established by the FAI, and to be valid, have to be homologated by this organisation. Records are registered under the name and nationality of the pilot (or the first pilot if it involves a crew) as being his property. In this way any pilot, whether private, military or commercial, may attempt to beat a record with a private, military or commercial aircraft, and may demand that this performance be homologated, this provided that his flight be carried out under the FAI rules. The different types of record are :

Distance records (in a straight line, with or without refuelling in flight ; in a closed circuit) ;

Altitude records ;

Speed records.

Each of these records again falls into three categories :

a) National record : can be established on any territory ; its nationality is that of the first pilot. The flight has to be authorised, controlled and homologated by the national aero club.

b) International record, according to class: The FAI has grouped aircraft into different classes : Free balloons, navigable balloons, landplanes, seaplanes, gliders, autogyros, helicopters, etc. An international record is that national record recognised by the FAI as being the best performance by a certain class of aircraft. It is forwarded to the FAI by the national aero club concerned and the documents pertaining to it are again revised. Provided these prove that the flight has been carried out in accordance with FAI regulations, the record is homologated. It can therefore occur that a national aero club accepts a record, but that the FAI declines to recognise it as such.

c) World record : The best aeronautical performance (distance, altitude, speed), regardless of the class of aircraft.

Existing world records

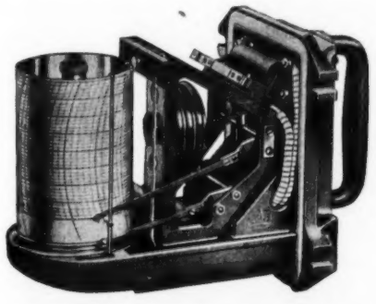
The following three examples give an idea of the difficulties which had to be surmounted in order to establish world records :

Altitude, in a free balloon, 11th November, 1935, by Captain Orvil (U.S.A.) 22,066 m

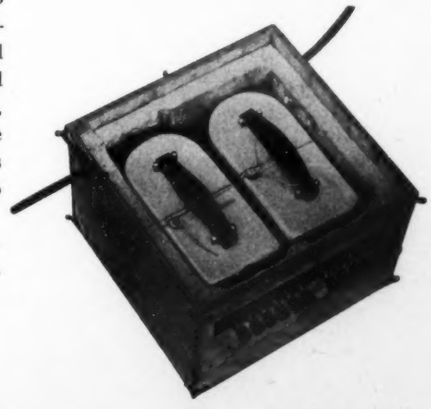
Distance in a straight line, in a landplane, 29th September/1st October, 1946, by Commander Thomas D. Davies (U.S.A.) 18,082 km

Distance in a closed circuit, in a landplane, 30th July/1st August, 1939, Lt.-Col. A. Tondi (Italy) 12,936 km

Even if the organisation of a distance record attempt does not present insurmountable



Non-compensated barograph with electrical heating and thermostat (top right). The air-tight casing has been removed.



Two sealed, non-compensated barographs in heat-insulated chamber (with lid removed). The two rubber leads are for conducting the static pressure.

difficulties, the high fuel consumption, the manufacture and adaptation of the necessary auxiliary tanks, and the wear and tear of the engines all represent expense factors which are beyond the means of the average private flyer.

The same applies to altitude records. Nobody would ever attempt to beat a record of this category without a specially constructed or particularly powerful aircraft.

For these reasons, and others besides, it is not surprising that the majority of record attempts can only be carried out with the financial assistance of aircraft firms, or under State auspices. It would seem that the days when intrepid pilots used to make attacks on records with their own personal aircraft are now over. Besides the conception of national prestige, such records also entail excellent publicity for aircraft and engine manufacturers. Though record performances have still retained their sporting character, they also involve a number of further considerations.

In order to give full play to the *homo sapiens* factor (piloting niceties, etc.), it is absolutely essential that the means used in the flight permit the performance to be homologated as accurately as possible. This is not always an easy matter. A primary requirement is that results be measured in identically the same manner in all countries, which cannot be achieved without recourse to standard regulations. The manner in which such measurements are effected, and the auxiliary means required, are briefly described below in the instance of altitude records.

Altitude records

Various methods may be applied in order to determine the altitude at which an aircraft is flying. The currently used method is based on the Law of Laplace, $dp = -a.dh$, and works with the determination of the air density at the aircraft's location. The symbols in this formula are: dp = change in pressure; a = specific weight of the air; h = change in altitude.

Integration of this equation between p_o and p_s (two levels of pressure presenting a difference in altitude of h) yields the following formula which, though mathematically correct and complete, is a little antiquated in form:

$$h + \sum_{1}^{n} h' = 18{,}400\ (1+0.00259\cos 2\varphi)\ c \sum_{1}^{n} \left[(1+\alpha t_m)\ (1+0.377\,E) \log \frac{p_o}{p_s}\right]$$

This is the formula of Angot, in which:

18,400 = physical and mathematical constant

y = latitude of the point of departure;

$(1 + 0.00259\ cos\,2\varphi)$ = factor to express the variation of gravity in function of latitude;

c = factor to express the variation of gravity in function of altitude: its value is calculated according to a fairly complicated formula, and is near to 1;

E = influence of the amount of humidity contained in the air.
In the FAI formula, the corrector factor $(1 + 0.377\ E)$ has been replaced by a constant calculated for mean values of atmospheric humidity, and is also near to 1;

α = gas expansion constant, 1/273;

t_m = mean temperature of an atmospheric layer in which there is a linear variation of temperature in function of altitude;

n = number of such atmospheric layers.

The formula of Angot indicates only the altitude of the aircraft above the point of departure; in order to obtain the absolute altitude H, the altitude h_o of the point of departure must be added. The FAI has derived a formula [1] from this, which is as follows:

$$H = \sum_{1}^{n} h' + x = 18{,}400\ (1 + 0.00259\cos 2\varphi) \sum_{1}^{n} \left[(1+\alpha t_m)\ \log \frac{p_o}{p_s}\right] + h_o + A + h^*$$

A = general corrector factor accounting for gravity variation with altitude and mean variation of the atmospheric humidity.

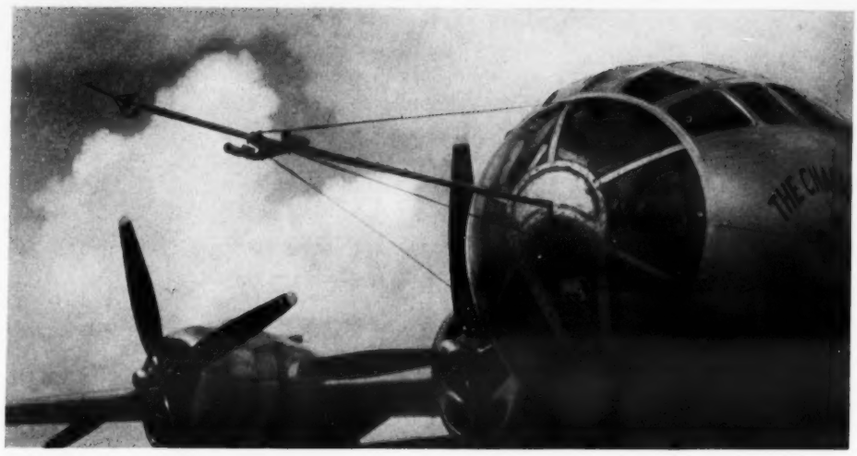
h^* = distance between the altimeter and the gondola (of a free or navigable balloon).

The regulations established by the FAI represent minimum conditions of precision required for homologation of a record. In cabin aircraft, as well as in all land- and seaplanes, the pressure must be measured with a static tube and accurate to within at least two percent of the dynamic pressure, this at all speeds and for flow angles between ± 30 degrees. The FAI has developed static tubes of its own; two different models are in use in France; and in the U.S.A. a pressure nozzle has been built which, thanks to a special device, constantly sets itself parallel to the relative wind.

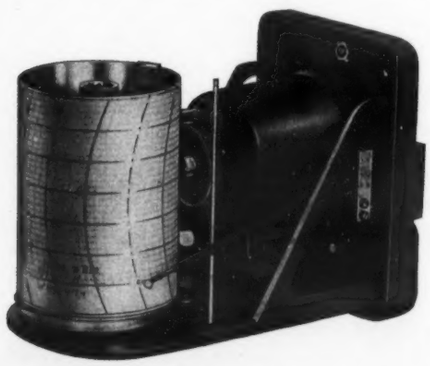
Barographs are extremely sensitive instruments which do not always work with the desired high degree of precision, so that every possible method must be sought to eliminate the sources of error. The main setback is that their pressure indications are influenced by the temperature. These instruments are therefore divided into two groups:

Compensated barographs, in which the temperature influence is compensated in such a way that a difference of 60 deg. C. causes an error in pressure recordation of maximum 1 mm Hg;

Non-compensated barographs, which can be placed in heat-insulated chambers in



Static pressure measured 3.20 m fore of the fuselage nose; the tube automatically sets itself parallel to the direction of flow. Two electrical resistance thermometers are located nearer to the fuselage.



Barograph, in which only the aneroids are encased (in the right-hand cylinder).

[1] The F.A.I. recognises a simplified formula for free balloons of less than 2,200 m³ volume, as well as for light land- and seaplanes, gliders, autogyros and helicopters.

which the temperature remains constant to within a tolerance of ± 3 deg. C. In a case of non-compensated barographs being exposed to strong variations in temperature, their recording errors must be determined accurately in function of the temperature.

For pressures in excess of 50 mm Hg, barographs are stipulated in which a pointer indication of 1 mm represents a pressure variation of maximum 10 mm Hg ; at greater altitudes 1 mm covered by the pointer must correspond to a pressure change of at the most 5 mm Hg.

Analogous regulations govern the accuracy of thermographs : the pointer must travel at least 1 mm for a temperature difference of 5 deg. C., and the thermal inertia (slowness to record) may not exceed 2 deg. C.

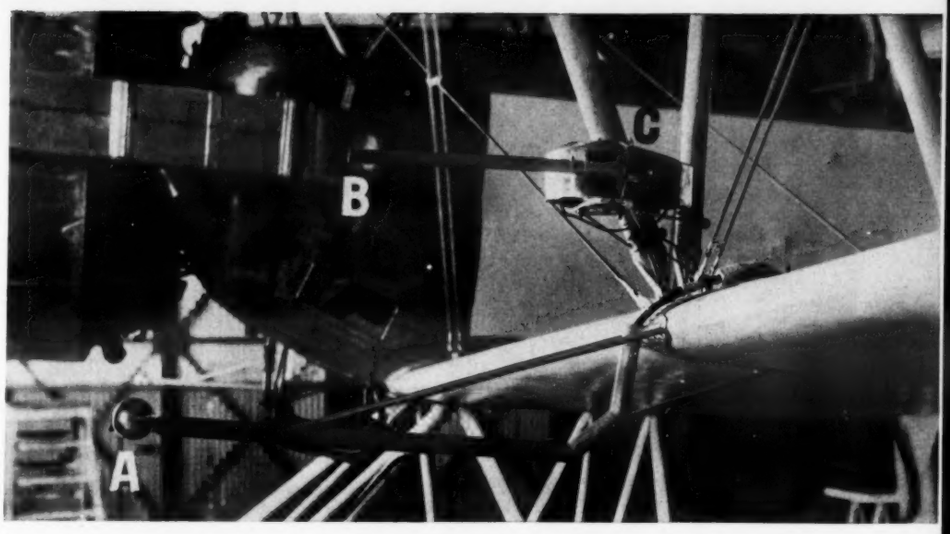
The FAI does not stipulate any special type of recording instrument, but only the conditions of precision which these must fulfil ; in this way the competitors may choose their own apparatus. The FAI can even go so far as to accede to special demands and authorise methods other than those prescribed, provided that these are equally accurate ; but it often occurs that tedious efforts are required in order to determine the new necessary corrections.

The FAI regulations indicate precisely the manner in which recording instruments must be gauged and verified. Certain national aero clubs stipulate verifications even more complete than those of the FAI. The Federation also prescribes methods for :

" artificial ageing " of aneroid barometers by applying alternating stresses ;
experimental determination of the influence of temperature on aneroid barometers ;
gauging of barographs at different temperatures ;
calculation of the compensatory pressure ;
verification of instruments if this has not been done for one or two months before a record attempt ;
gauging thermometers between + 25 and — 60 deg. C. ;
installing instruments in aircraft.

The static tube must be installed fore of the wing leading edge at a distance corresponding to 60 percent of the wing chord at this point ; and must also be situated at a distance below the airfoil chord equal to 15 percent of the chord. These prescriptions are in order that the static tube be outside the aircraft's aerodynamic zone, and thus often entail complicated methods of installation.

The regulations listed above form only a portion of those established by the FAI to incorporate the highest possible degree of accuracy in the homologation of altitude records.



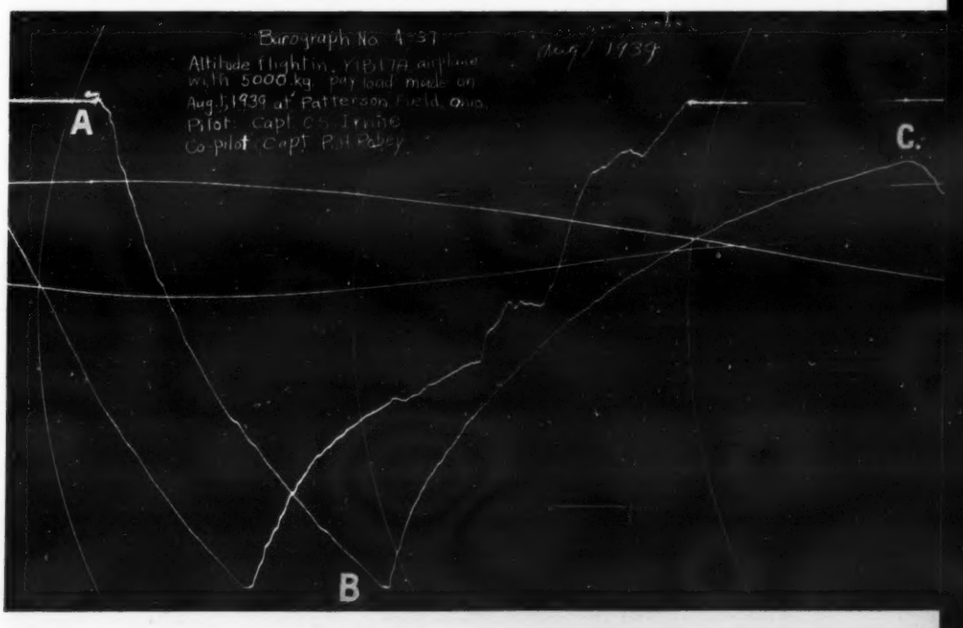
Static tube A, *installed in the prescribed manner fore of the wing leading edge ; cooling tube* B, *for ventilating the thermographs protected against the sun in casing* C.

In order to obviate any fortuitous overlapping of record performances and to provide absolute guarantee that an earlier homologated record has effectively been beaten, certain " margins " are stipulated. In this way, a new altitude record is only recognised if it is superior to the previous performance by at least :

200 m, if the new record is below 10,000 m ;
300 m, if the new record is between 10,000 and 24,000 m ; and
500 m, if the new record corresponds to a minimum pressure of at least 1 mm Hg below the pressure previously homologated.

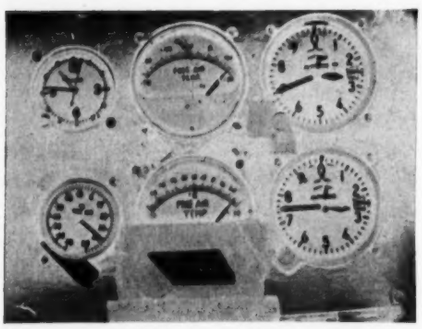
Record Attempt	Altitude				
	Homologation m	Altimeter Reading		Barograph Reading	
		Official m	Reserve m	Official m	Reserve m
a	14,603	13,899	13,881	16,700	—
b	14,180	13,360	13,463	18,850	—
c	13,793	12,963	12,984	18,840	—
d	12,668	12,006	12,006	16,700	14,800
e	12,046	11,392	11,380	17,100	—

Many people will wonder whether such rigid rules are really necessary ; whether they are not just a sign of scientific pedantry. Rather than with a long list of technical considerations which would not convince everybody anyhow, the question is best answered with a few data, as given below,



American barogram : A, *take-off ;* C, *minimum pressure recorded. In order to permit greater pressures to be recorded, the pointer changes its direction once a certain pressure* B *has been reached.*

European barogram: altitude flight up to about 6,200 m of a two-seater glider.



Recording instruments which register readings every two seconds on a film can replace barographs and thermographs. Top left: chronometer, below which the temperature of the altimeter casing is visible; centre: two separate thermometers for exterior temperature; right: sensitive altimeter with three pointers.

which are taken from the documents pertaining to recent record attempts.

All numbers written on the same line correspond to the same record attempt. Those in the 'homologation' column are the altitudes attained, calculated according to the complete formula given above. The figures in the other four columns are the uncorrected instrument readings, whereby both altimeters were coupled to the same static tube. The barographs were housed towards the rear inside the fuselage. The altimeter corrections reveal errors of the order of ± 70 m for altitudes between sea-level and 15,000 m, whereas columns 3 and 4, in which the results are almost identical, amply testify to the accuracy of the two instruments. However, their readings are rather at variance with the homologated results (2nd column). Taking into account the altitude of the airfield of departure (38 m), instrument errors, influences of gravity variations and atmospheric humidity, there still remains a difference of 500 to 700 m between the real altitude and that indicated by the instruments. This margin of error finds its source in the variations of temperature between the atmospheric layers through which the aircraft has flown. It is therefore an example of the necessity for accurate measurement of temperature. In view of the strong ventilating action caused by the speed of modern aircraft, the thermal inertia is feeble. If the air cannot flow freely around the sensitive organs of the thermographs, or if there are exposed to the full impact, then the kinetic energy of the air particles can produce another error which can eventually exceed 10 deg. C.

The differences appear still greater if the column containing the homologated altitudes are compared with those containing the uncorrected barograph readings (columns 5 and 6). Very low temperatures seem to have a strong influence on the accuracy of the barographs; and the differences between the pressure prevailing in the static tube and that inside the fuselage, which can amount to over 5 mm Hg (corresponding to an altitude difference of approx. 300 m) at — 60 deg. C. and 15,000 m, are very evident.

The above details are indicative of the necessity of careful installation of the measuring equipment and close observation of the gauging and verifying rules. This aerological method of determining altitudes may seem to be unduly complicated, but it is all the same the most simple one. The measuring equipment weights little and need not be installed in the aircraft for purposes of preparation and verification. The most complicated part of the procedure is the installation of the static tube outside the aerodynamic zone of the aircraft. Otherwise, there is the advantage that this method entails no costly equipment, airborne or on the ground; it can be used in all weathers and in all parts of the world, giving the pilot free choice of where to fly.

Future Altitude Records

Though it is relatively simple to measure pressures and temperatures at altitudes of 20,000, 25,000 and even 30,000 m with aneroid barometers and conventional thermometers, it will not be so easily possible at greater altitudes. The existing methods will therefore have to be revised and adapted to technical progress.

A suggestion at present under examination is that the aircraft's position be determined by radio. There can be no objection to such a method, provided it incorporates sufficient accuracy (e.g. + 50 m at 25,000 m altitude), is applicable to all countries and all pilots, does not load the aircraft down with heavy and delicate equipment, and that it can be used in conjunction with any type of aircraft (balloon, glider, aeroplane) regardless of the type of constructional material these embody. Consideration is also being given to methods derived from radar principles, or those of modern navigational systems (Decca, Consol, Loran, etc.). The FAI commission charged with these questions does not favour one method more than another. It will confine its efforts to selecting the method which offers the best combination of simplicity and accuracy.

PERFORMANCE CALCULATION FOR HELICOPTERS

By Walter Just, D. Sc.

Concluded [1]

Should measurements be available for the coefficients k_a, k_w and k_d, the values ζ_{LV} and η_s are to be calculated according to equations (54) and (56), this in taking into account equation (51), which has so far not been used here. Otherwise these coefficients have to be obtained by means of calculation, which is relatively tedious and requires too much space for description here. Meanwhile, in order to acquire a rapid survey, brief formulæ can be provided for the coefficients k_a, k_w and k_d, which are derived from the exact calculation procedure with certain items neglected. However, these formulæ are actually so accurate that they allow power conditions to be calculated with sufficient exactitude for practical application:

$$(58) \qquad k_a = 2\sigma_{0.7}\,\vartheta_{0.7}\left(1+\frac{3}{2}\lambda^2\right)+3\sigma_{0.7}\delta$$

[1] Cf. "INTERAVIA REVIEW" No. 3, March, 1947, P. 34-41.

(59) $$k_w = \sigma_{0.7}\frac{\lambda}{2}c_{wP} + k_a\,(\alpha + a_1)$$

(60) $$k_d = -k_a\left(\delta + a_1\lambda\right) + \frac{\sigma_{0.7}}{4}c_{wP}\left(1 \times \lambda^2\right)$$

whereby: $\sigma_{0.7}$ = surface density $= \dfrac{zt_{0.7}}{R\pi}$

$\delta = \lambda\alpha - k_a/4\lambda$ = flow factor

α = rotor angle of incidence

a_1 = flap coefficient of the blade flapping movement,

$\beta = a_0 - a_1\cos\psi - b_1\sin\psi$

$c_{wP} = c_{w0} + c_{w_2}\alpha^2_{eff}$ = blade airfoil drag

For normal airfoils: $c_{w_0} = 0.011$; $c_{w2} = 0.40$; $c'_{a\infty} = 5.6$

thus $c_{wp} = 0.011 + 0.013\,c_a{}^2$

$\overline{c_a} = 3.2\,\dfrac{k_a}{\sigma_{0.7}}$ = mean c_a for the rotor blades.

By introducing δ, k_d works out at

(61) $$k_d = -\lambda k_a(\alpha + a_1) + \frac{k_a^2}{4\lambda} + \frac{\sigma_{0.7}}{4}c_{wp}\,(1+\lambda^2)$$

The condition of equation (15) results in

$$k_a(\alpha + a_1) = -c_{ws}\lambda^2 - \frac{\sigma_{0.7}}{2}\lambda\,c_{wp}$$

By substituting this expression in equation (61), ζ_{LV} and η_S are obtained according to equations (57) and (56):

(62) $$\zeta_{LV} = \eta_s\frac{\sqrt{k_a}}{2\lambda}$$

(63) $$\eta_s = \frac{\lambda k_a}{\dfrac{\sigma_{0.7}}{4}c_{wp}\,(1+3\lambda^2) + \dfrac{k_a^2}{4\lambda} + c_{ws}\lambda^3}$$

In order to provide an example, Figs. 15 and 16 contain ζ_{LV} and η_S in terms of equations (62) and (63), plotted for the thrust coefficient $k_n = 0.010$ and the disc density $\sigma_{0.7} = 6\%$, with the parasite drag c_{ws} as parameter. With these curves, which can be calculated fairly rapidly, a quick answer is provided to the various questions arising in connection with the horizontal flight condition. The influences of the various constructional values, such as gross weight, power, rotor diameter, disc density, rotative speed, parasite drag, etc., are clearly represented in these curves. In addition, it may be mentioned that, in view of the simplifications which have to be introduced if reasonably handy formulæ are to be provided, the validity range of the afore-mentioned short formulæ (equations 58 to 60), and thus the expressions for ζ_{LV} and η_S according to equations (62) and (63), is limited, and this namely to an advance factor of about $\lambda = 0.35$ and a mean blade loading of $\overline{c_a} = 0.9$; a well-conceived helicopter, however, comes within these limits. The calculation procedure for the maximum speed, for instance, is roughly as follows: gross weight G (kg), engine power N (H.P.), rotor diameter D (m) and the helicopter without rotor drag coefficient c_{ws} are given; firstly, $N = N_{Mo}\cdot\eta_G$ is calculated, then N/G, G/F and, with equation (53),

$$\zeta_{LV} = \frac{1}{N/G\;37.5}\sqrt{\frac{G/F}{\varrho/\varrho_0}}$$

Subsequently, with the help of the curve in Fig. 15, ζ_{LV} and c_{ws}, the advance factor λ may be obtained. Then, with λ thus calculated, the η_S curve (Fig. 16) provides the high speed efficiency ηs, and the speed from $v = \eta s \cdot 75\,N/G$ (m/sec). The blade tip speed and rotative speed are then worked out in the following manner:

$$U = v/\lambda;\; \omega = U/R;\; n_{Ro} = \omega \cdot 9.55\;[r.p.m].$$

With this the reduction ratio between engine and rotor has been established. If, however, this ratio is given initially, the procedure of calculation is along other lines. One begins with a series of λ values, e.g. approx. 0.2; 0.25, reads ζ_{LV} and η_S from the curves, calculates the rotor power

$$N = \frac{G}{\zeta_{LV}\cdot 37.5}\sqrt{\frac{G/F}{\varrho/\varrho_0}}\quad [H.P.]$$

and the speed $v = \eta_S \cdot 75\,N/G$. Following this, the speed v curve may be plotted in function of the rotor power and, by means of the engine power $N = N_{Mo}\cdot\eta_G$ corresponding to the rotative speed in question, the maximum speed is obtained. These calculation procedures are valid for variable-pitch rotors as k_a = constant in the ζ_{LV} and η_S curves. In the case of fixed-pitch rotors, thus $\vartheta_{0.7}$ = constant, it is best first to plot the ζ_{LV} and η_S curves for fixed $\vartheta_{0.7}$ values; it is then possible, as above, to calculate the powers in the horizontal flight condition.

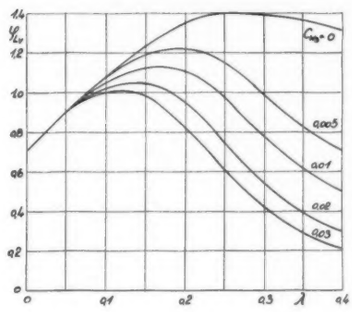


Fig. 15: Performance factor ζ_{LV} for horizontal flight.

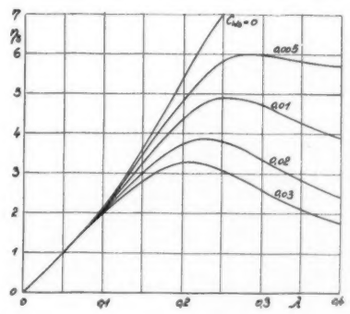


Fig. 16: High speed efficiency η_S.

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Landing Wheel Pre-Rotation

Advocates of flying-boats repeatedly point with justification to the landing-gear as one of the main drawbacks of all very heavy landplanes. Apart from the strain it imposes on the runway, the retractable type of undercarriage of a modern airliner also represents a considerable part of the constructional weight and, moreover, a part which can offer the designer a certain amount of difficulty.

The great weight and high speed with which long-range commercial transports land on hard-surface runways place heavy demands on the quality and strength of tires. At the moment when a heavy aircraft first touches the runway a smoke-cloud, caused by the friction of the stationary tire with the rough surface of the runway, can usually be discerned, which, together with the accompanying characteristic noise, is manifest of the enormous strains imposed. In consequence, a method was sought to alleviate the landing shock by setting the main wheels in rotation during the approach and having them turn at a speed corresponding as accurately as possible to the aircraft's touch-down speed.

It is certain that this research was initially provoked by a desire to cut down the wear and tear of tires, for even experts in the branch were accustomed to believe that the landing shock was the primary cause of tire deterioration. Meanwhile, however, closer experimenting surprisingly proved that it was not the landing shock, but other, totally different, undesirable factors which tended to curtail the life of aircraft tires. Apart from damage caused by alien matter on the runway, it is actually the parts of the tire located near to the hub which, subjected to the heat of the brake drums and heavy mechanical stresses, are the first to reveal defects and necessitate replacement of the tire.

Meanwhile, an aircraft wheel pre-rotation mechanism for heavy airliners is necessary for another reason. The inertia of a modern heavy landing wheel is so great that the initial touch-down can almost be compared to a keel landing. When the stationary wheels of a heavy aircraft touch the runway at the usual landing speed of modern transports (about 90 m.p.h.) the result is that, until they have been completely accelerated, an additional stress is imposed which exceeds the landing shock taken into account in the calculation of the undercarriage. As it is often the case that this acceleration proceeds in a pulsatory manner, whereby each minor bump causes a new impulse to be transmitted, the danger is not only that these impulses can damage certain parts of the undercarriage, but also that oscillations could eventually develop and be transferred to the airframe. Hence, if the majority of aircraft firms are today engaged on the problem of landing wheel pre-rotation, this is because of reasons quite different from what is generally thought.

It was tried first of all to use the drag wind to drive the wheels. But suitable shaping of the tires and fitting wind cups to the hub made it possible to attain a rotative speed which amounted to only 60 per cent. of the landing speed. The results obtained were even less favourable in aircraft with twin landing wheels arranged in tandem, because the rear wheel lay in the vortex of the front one and consequently could hardly be set in motion.

This problem presented itself during development of the four-engined Lockheed "Constitution", of which the landing gear, consisting of two tandem-set pairs of twin-wheel groups, has to support a gross weight of about 73 tons. Lockheed Aircraft Corp. stipulated a pre-rotation mechanism requiring operation of not more than five minutes for each landing and permitting two consecutive landings to be made within fifteen minutes. After experimenting with devices ranging from electric motors fixed to the undercarriage struts and geared to the wheel, to small gasoline engines coupled via a chain

O. E. Dever, designer of the electric pre-rotationdevice for aircraft landing wheels

Outer armature (left) and field unit (right) of the Dever d.c. motor

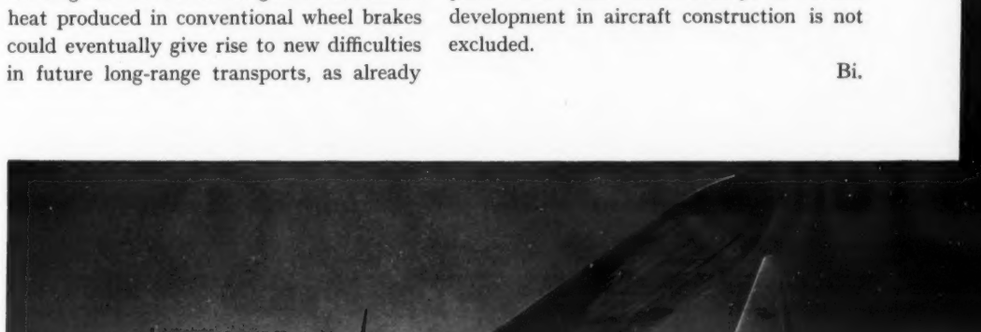
drive to the wheels, the final choice was given to a system developed by an American constructor of the name of Otto E. Dever. Dever made use of one of the most antiquated types of electric motor, a d.c. model using ring-type winding, which is made up of an outer armature ring of 168 segments revolving with the wheel, and a field unit of 12 coils fixed to the non-rotating wheel axle. Fed with an input of 120 volts/50 amperes, the Dever motor can supply a short-duration starting power of 6.7 kW (9 H.P.) ; a power of 1.5 kW (2 H.P.) is sufficient to maintain peak rotation. The entire pre-rotation system weights 15 lbs., the armature ring measuring 10 in. in diameter and 1¼ in. in width. It has been designed to rotate the landing wheel at 630 r.p.m., corresponding to a landing speed of 90 m.p.h. Each of the Lockheed "Constitution's" eight main landing wheels is equipped with one of these devices, so that they can be revved up to full pre-rotation speed in two minutes and thus held to within 6 percent of the landing speed.

The fact that engineers are now taking heed of the great constructional weights of modern aircraft and are endeavouring to eliminate dangerous undercarriage oscillations with landing wheel pre-rotation, may be regarded as the first step of a novel development. It may be assumed that sooner or later they will try to pre-rotate the wheels not only before landings, but also during take-offs. As long as the efficiency of jet power plants remains unsatisfactory at low speeds, there does not seem to be any reason why take-off assistance should not be supplied by a method of direct power transmission from the turbine shaft to the landing wheels. In what manner it will be possible to transmit high outputs to the landing gear remains to be seen ; at all events, the putting into practice of such an idea does not seem improbable, as present take-off aids such as catapults and rockets have hitherto proved expensive and unsuited to commercial aviation.

Medium-size landing wheel fitted with Dever pre-rotation system

Following long years of research, nearly all countries today have reversible-pitch airscrews for brake-action at landing and for ground manœuvring of heavy transports. With the advent of pure jets, it will also be necessary to devise new methods for land braking. A means of leading off the frictional heat produced in conventional wheel brakes could eventually give rise to new difficulties in future long-range transports, as already today it is necessary to construct extremely flat, high-pressure tires for use with thin airfoils. In order to spare his brakes, the motorist uses the engine to cut down the velocity of his vehicle ; once a power transmission between landing gear and aeroplane has been made reality, a similar development in aircraft construction is not excluded.

Bi.

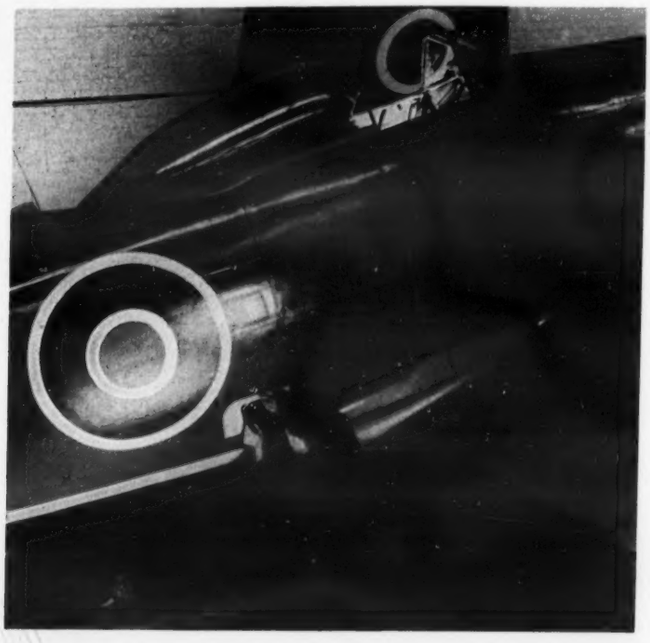


Lockheed "Constitution," of which the eight main landing wheels are equipped with electric pre-rotation.

Reconnaissance Fighter

Arrangement of the oblique camara; in the foreground the adjustable mounting.

Camera in the fuselage side of a Hawker " Fury ".



Due to the steady improvement of the performance of interceptors and the continuous increase in the efficacy of anti-aircraft artillery, attempts at aerial reconnaissance with conventional equipment became an almost hopeless enterprise during the late war. Soon it was found necessary to create new aircraft, capable of fulfilling their task in the face of much heavier defences. A logical step was to eliminate any kind of superfluous load in favour of greater flying-speed and heavier armour protection.

Long-range reconnaissance, usually flown without fighter escort and at very high altitude, was mostly carried out by twin- or four-engined bombers carrying complete photographic equipment in place of defensive armament. More complicated was the case of short-range reconnaissance, because the air crews were often given obsolescent aeroplanes of poorer performance and had to rely on powerful fighter escorts.

In 1944, reconnaissance squadrons of the Allied air forces were equipped with North American P-51 and Vickers-Supermarine " Spitfire " single-seater fighters for the first time. These proved their worth in every respect and now seem to justify the present tendency towards the final abandonment of the two-seater short-range reconnaissance aircraft. It has been found possible, in effect, to entrust the two main duties of the observer in the two-seater type—operation of defensive guns and photographic cameras—to the occupant of a single-seater. The absence of defensive armament is more than balanced by superior speed and good manœuvrability of the fighter, and the remote-controls of the cameras have been developed to a point where they can easily be operated by the pilot himself. In view also of the smaller number of personnel required, the employment of two-seaters for this particular purpose seems no longer justified.

Recognising the new situation, *Hawker Aircraft, Ltd.*, of Kingston-on-Thames, Surrey, developed a *short-range reconnaissance aircraft* by slightly modifying their well-known " *Fury* " single-seater fighter, without, however, sacrificing any of that type's outstanding characteristics. On reconnaissance missions the " Fury, " of which a well-known naval version, the " Sea Fury, " has been in existence for some time[1], carries two automatic F. 24 cameras mounted in the lower fuselage half directly aft of the cockpit. The lens of the vertical camera can vary in focal length from 5 in. to 20 in., and that of the oblique camera, fitted facing starboard, from 8 in. to 20 in. The oblique camera can also be depressed from 0 to 20 degrees below the horizontal. This equipment enables the pilot to take serial shots vertically from above, as well as sideways when flying past at low altitude.

Fitted with 90-gallon long-range fuel tanks jettisonable in emergency, the aircraft possesses a range of 1,900 miles at a cruising speed of 300 m.p.h. Thus, the Hawker " Fury " is suitable not only for short-range tactical reconnaissance missions in conjunction with close-support of ground forces, but, with certain limitations, also for long-range strategic reconnaissance duties.

[1] Cf. " INTERAVIA, Review of World Aviation, " August, 1946, P. 37.

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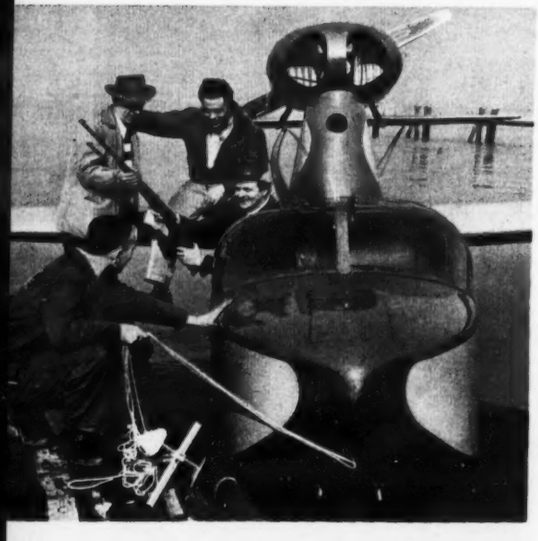
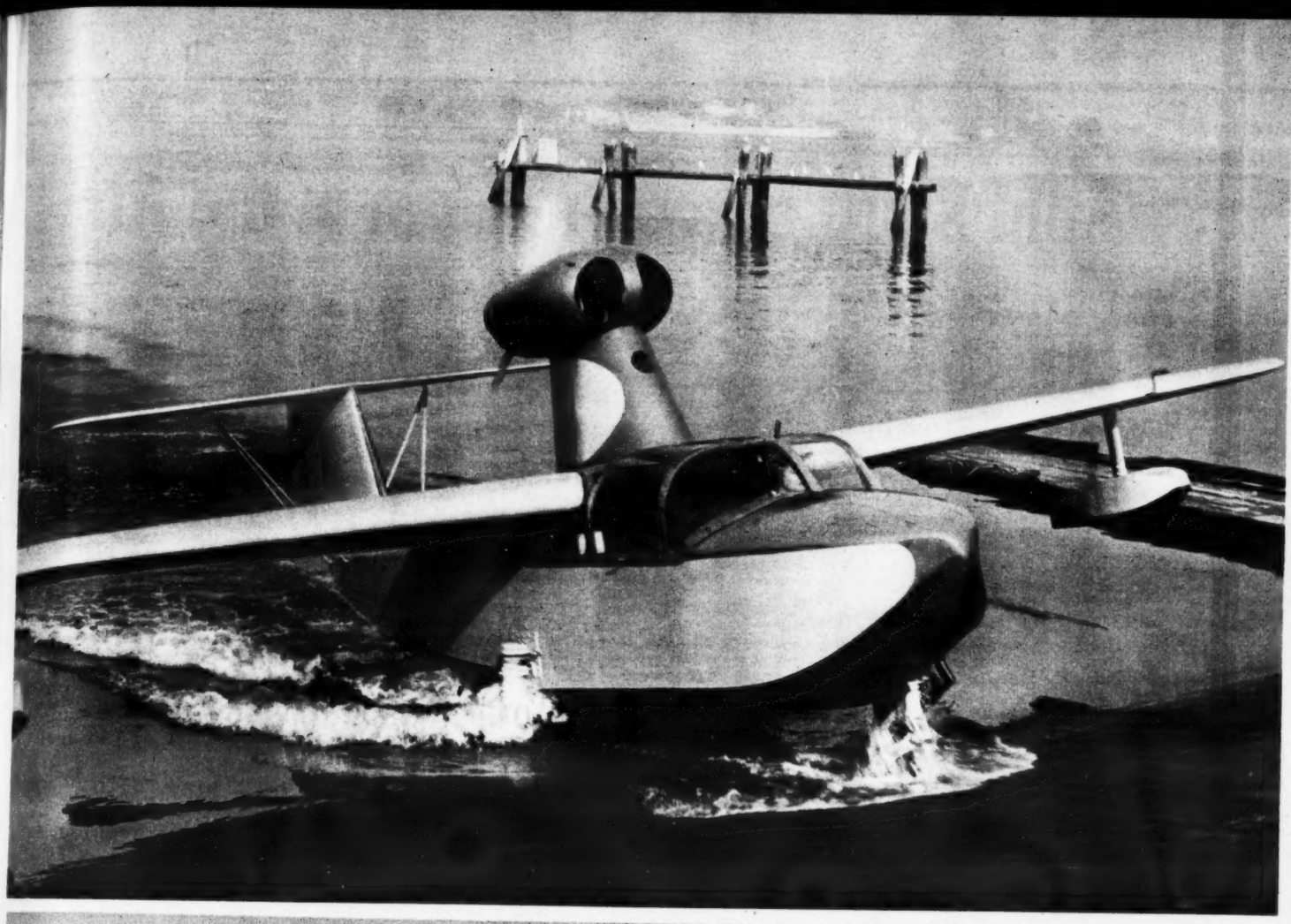
A New Amphibian for Private Pilots



Which private pilot has not at some time or other regretted that his landplane tied him down to established airfields, giving him no free choice over where to land ? The amphibian aircraft, which to a great extent removes this tie and represents more or less the ideal type of private plane, has so far not met with great success. The chief reason has been the high costs of manufacture, putting amphibians beyond the reach of all except those with well-lined pockets.

Kenneth L. Bunyard, a New York aircraft constructor, has now come forward with the *Bunyard "Sportsman"*, a light four-seater amphibian powered with a 185-H. P. Franklin air-cooled flat-six, which should sell at a reasonably low price. Entirely of wooden construction, it is equipped with a tricycle landing gear of which the nose-wheel retracts into the hull and the main wheels turn upwards through 180 degrees so as to lie partly contained in the wing roots. The engine, which drives a two-blade controllable-pitch airscrew, is mounted on a superstructure above the centre fuselage and is thus accessible from all sides. The accompanying photos of the "Sportsman" show clearly the designer's aim towards a straightforward and robust construction, providing great simplicity of maintenance. The gross weight is not likely to exceed 3,000 lbs., so that with a span of about 34 ft. 6 in., favourable take-off and landing characteristics can safely be counted on, as well as a cruising speed in the vicinity of 120 m.p.h. *Bi.*



The old Story of the Freedom of the Air

By Dr. L. H. Slotemaker
Vice-President of KLM Royal Dutch Airlines

Dr. L. H. Slotemaker, Vice-President, K. L. M. Royal Dutch Airlines.

At the International Civil Aviation Conference in Chicago (November and December, 1944) an air agreement was drafted on the basis of the "Five Freedoms". This fulfilled U. S. desires, and both Holland and Belgium, for instance, agreed to it. Meanwhile, however, Great Britain and a number of other countries opposed a multilateral pact of this kind, with the result that, in 1946, the U. S. A. also turned against it, and decided in favour of bilateral air agreements. This meant that the cherished "Freedom of the Air" was momentarily over with.
Within PICAO, however—which, having discarded its provisional rôle, has assumed the name of ICAO since April 4th—an effort is still being made to introduce a multilateral agreement, thus the "Five Freedoms", thus the full Freedom of the Air. A new draft of a multilateral pact was submitted to the Organisation's Air Transport Committee at the end of last February, which will be examined at the ICAO Plenary Session next May in Montreal.
During discussion of this draft by the Air Transport Committee, the Canadian, Anson C. McKim, seconded by the French representative, Henri Bouché, severely attacked the policy of bilateral agreements, which could be influenced by political pressure alien to aviation, and demanded an international policy with equal rights for all.
Below is the opinion expressed by Dr. L. H. Slotemaker, Vice-President of KLM Royal Dutch Airlines, in whose words another bid is made for the Freedom of the Air.
A member of the Netherland delegation to ICAO, Dr. Slotemaker emphasises that his words are not based on any legal viewpoint, but on the purely logical considerations of an airline executive. At the present time, during which we so glibly speak of democracy and freedom, it would be well if we endeavoured to make way for freedom, at least for the Freedom of the Air.
The Editor.

In civil aviation we had two post-war phases. In 1919, when the Paris Air Convention was drawn up, an unmistakable tendency to give a chance to civil aviation existed, and this distinctly appears from the minutes. However, this wish was not clearly formulated in the wording of the famous article 15 and gradually the freedom of passage for international air services fell into the background, particularly when it became apparent that civil aviation was not self-sufficient. But despite all sorts of barriers thrown up, aviation managed to develop ; and, moreover, a general convention (and two other conventions of the same type) existed, to which the greater part of the airfaring states adhered : two very important facts indeed, which, after the second world-war, ought to have been remembered. I admit that, in Chicago in 1944, an effort was made and some old defendants of the principle of freedom of the air based on a multilateral agreement, such as the United States, Sweden and the Netherlands, tried to get their ideas accepted ; but they did not succeed.

What is the position now ?

There is no generally-accepted multilateral agreement. Only a small number of states, among which but a few operate airline services on an important scale, ratified the International Air Transport Agreement of December, 1944. Attempts to come to a new draft, acceptable to the majority of countries, failed in June, 1946.

And actually there is no such thing as freedom of the air. There only seems to be a bilateral bargaining all over the world, with all sorts of new features, such as "reasonably direct lines", "homeland" interpretations, extension of the cabotage principle to traffic between neighbouring countries, designations of certain airports, obligatory landings, and so on.

Well, that is what the world did with regard to the enormous possibilities civil aviation has to offer, possibilities so eloquently described in speeches and official documents, but not given a big enough chance.

Now, in May, 1947, another draft of a multilateral convention will be submitted by the ICAO Council to its members for discussion and possible decision ; and Governments will again appoint representatives to control and guide national civil aviation. Of course, this is not the right place to discuss the merits of the new draft. On the other hand, however, I feel it would be appropriate here to stress not only the desirability, but also the necessity, that all airfaring countries should give every chance and help to civil aviation. Besides being the quickest means of transport, it is by its very nature international. Unrestricted by earthly obstructions, it can go the direct way into the heart of a country.

Too often it happens that, during discussions in conferences and smaller meetings, every item is carefully examined and talked over at great length, whereas the interests of the travelling public are just forgotten. But the fact is that civil aviation owes its existence neither to Governments nor to airline companies, but to this travelling public ; it will always do so, and precisely for this reason the public interest must necessarily be given precedence. Route networks and timetables must be planned out in accordance with public desires and purposes. It is to the disadvantage of both passengers and carriers, as well as of public convenience and necessity, if artificial restrictions are imposed on air travel, such as granting some the right to embark and disembark international cargo on certain routes, and denying it to others, or if an airline cannot obtain authority to run a service which seems to be of the highest importance to its development. If this continues, it is almost certain that the travelling public will ultimately put forward a strong protest, and will enforce Governments and air traffic companies to take heed of public interest, which constitutes the airlines' source of revenue and must therefore be looked after.

Why all these restrictions and discriminations ? The argument is that this policy is adopted in order to protect the national airlines from too much competition. However, judging from the results thus far achieved, it may be seen that aviation run on a broad basis is much more economical than when conducted on a small scale. Of course, feeder and local services are also needed. In order to attain the most economical exploitation, it is indispensable that aircraft be used intensively and that flying staffs be educated gradually to the increasingly difficult tasks of their companies.

If these principles are recognised, then freedom of passage constitutes a necessary requirement to each participant in civil aviation. It is true that not all states desire, or are in a position, to indulge in aviation on a large scale : but then there is a choice between no national aviation at all, in which case a country would be wise to open its airspace to other countries so as to provide quick connections with the other

parts of the world ; or else a relatively modest local air network, connecting with neighbouring countries. At all events, it must be kept in mind that as soon as one wants to get further, one needs freedom.

And anyway, restrictions are not only damaging the interests of the travelling public, also those of the air traffic companies, on behalf of which they are supposedly put up. One of the main purposes of airline companies ought to be to make profits, that is to say, to carry as much cargo as possible at the most economical tariffs. This purpose cannot be achieved completely if a carrier strives to reserve all traffic for its own limited frequencies. Better would be to promote an increase of frequencies, thus admitting foreign companies too, and in this way increasing the possibilities of air travel. Experience so far obtained shows clearly that opportunity creates traffic, and that traffic creates prosperity.

All these restrictions are contrary to the real character of international aviation. They divide up a world which is very much in need of the advantages aviation can offer, and which should, therefore, be opened to it. Experience will again show that it is impossible to hold up the development of civil aviation with artificial impediments. Commercial flying will doubtlessly succeed, and it would indeed be well that this be acknowledged in good time by those who soon have to decide on the multilateral agreement.

There must be no fear, no compromise, but conviction.

Feeling Sick?

Lots of people positively refuse to go up in aeroplanes for fear of feeling sick. Now, this is just one of those popular fallacies and, moreover, if you come to think of it, an entirely incongruous one. For if one decided to feel sick every time there were real grounds for feeling sick, life would not be worth living.

Just think back on one of the menus of our ancestors' days ; the usual type of meal served at any wedding, family re-union or festive occasion. In the sixteenth century one of these lunches would consist of at least : 43 ragouts, 21 roasts, 10 salads and 42 sweets... And these gargantuan appetites were still in vogue a couple of hundred years later. Let us take a look at the menu served in honour of the King of France on January 17 th, 1750, at the Château de la Muette : two entrées (veal and sirloin), two soups, sixteen varieties of game (roast quail, woodcock, partridge and pheasant, etc.), four first main dishes (venison, ham, etc.), 12 roasts, 15 entremets (foie gras, tongue in aspic, etc.), and a list of desserts, wines and liqueurs, long enough to fill this page.

Now, this *was* something to feel sick about.

The other day I was reading a biographical account devoted to Victor Hugo's exile on Guernsey. " His stomach ", it says, " is like his mind, fast and sure in its functioning. He can eat vast quantities and amazing mixtures of food ; several dishes of cold meats, salads, vegetables and highly-spiced sauces, are just a snack to him ; and like Louis XIV, he can eat several chicken in succession : he once shocked his family by eating six oranges with the peel on... ".

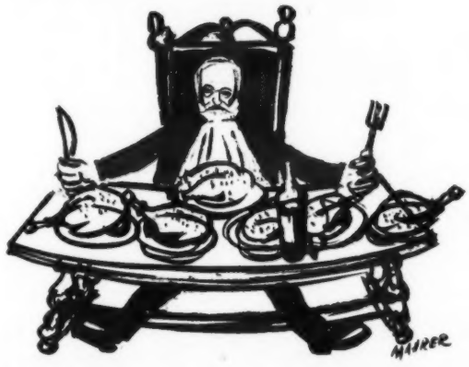
But there is no record of *his* ever having felt sick.

* * *

And what about the atomic bomb ? Don't you ever get a queer feeling inside your stomach when you read of this weapon's fiendish capabilities.

At Bikini last July, it threw up a water-spout over two thousand feet high : ten million tons of water ! Well, certain American admirals, not feeling so good either about this little fountain, hurriedly had plans worked out for a new class of warship to withstand the impact effects of nuclear fission. Some six months later these plans were nearing completion ; theoretically, the new ships existed and could be launched. The admirals were feeling better again.

But, alas, an American engineer comes along



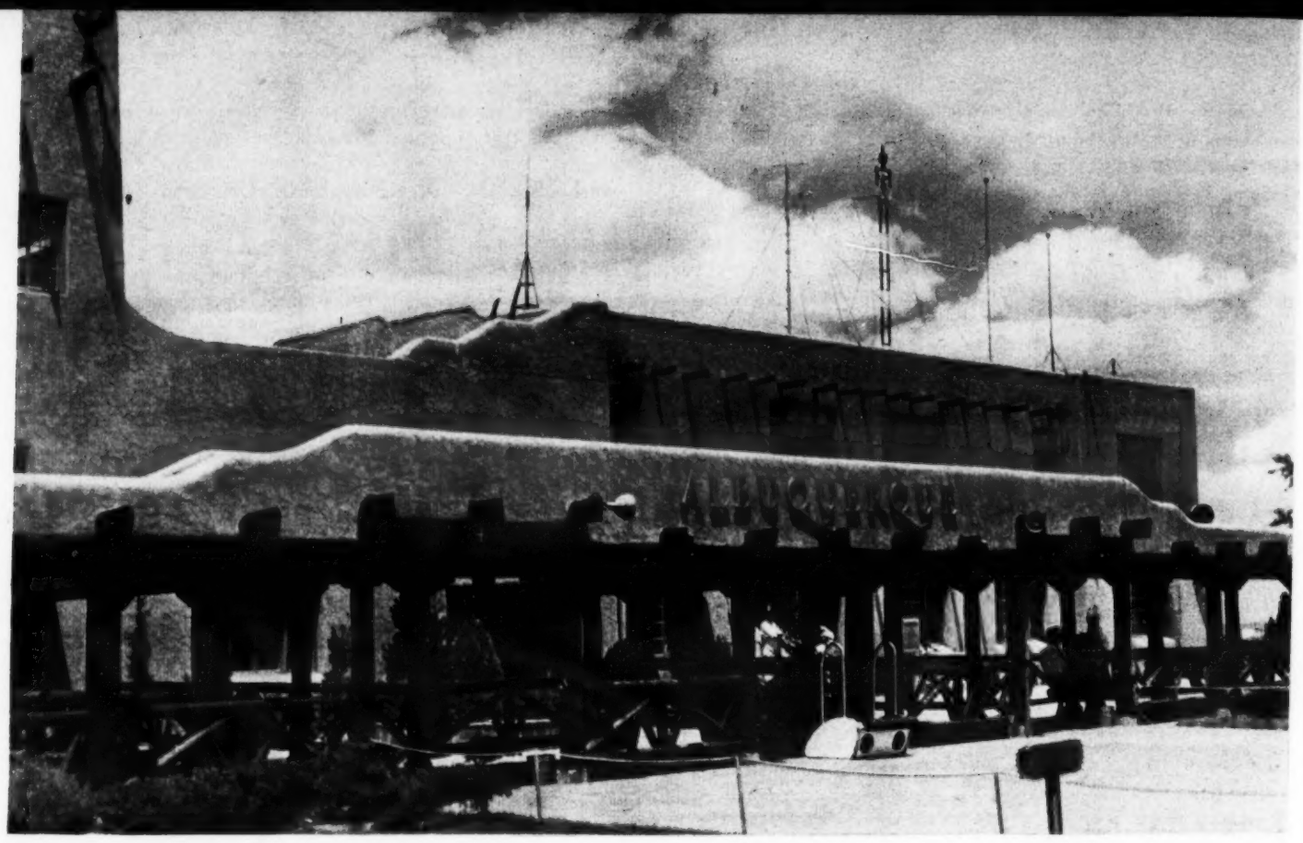
with the disconcerting news that last year's atomic bombs are only small miniatures, and that the new models will be a thousand times more effective. Did the admirals feel sick ? They must have felt so giddy that they had to hold fast on to the deck-rail for fear of toppling into the abyss of their own illusions !

* * *

You see, it is not going up in aeroplanes which ought to make you feel sick, but plain, everyday circumstances.

And, besides, if the quantity of tripe which present-day politicians expect people to digest has not yet steeled the public's stomachs, what will... ?

Yves Grosrichard.



Spanish-Indian architecture of the administration building. Food and refreshments are served on the patio.

ALBUQUERQUE

AIR GATEWAY TO THE WEST

Church at Albuquerque, built by Spanish missionaries who followed the Spanish colonisers.

Derned benzine buzzards. Shore turned things upside down around here," says G. A. M. Wilson, hooking his high-heeled cowboy boots over the rungs of a bar stool at the Albuquerque airport administration building.

Philosophical about the changes that have come during his lifetime, this aging rancher, a local fixture whose herd of white-faced cattle once grazed over the entire mesa where the airport is situated, all the same has a twinkle in his eye—understandably, when one thinks of the price he probably got for his land.

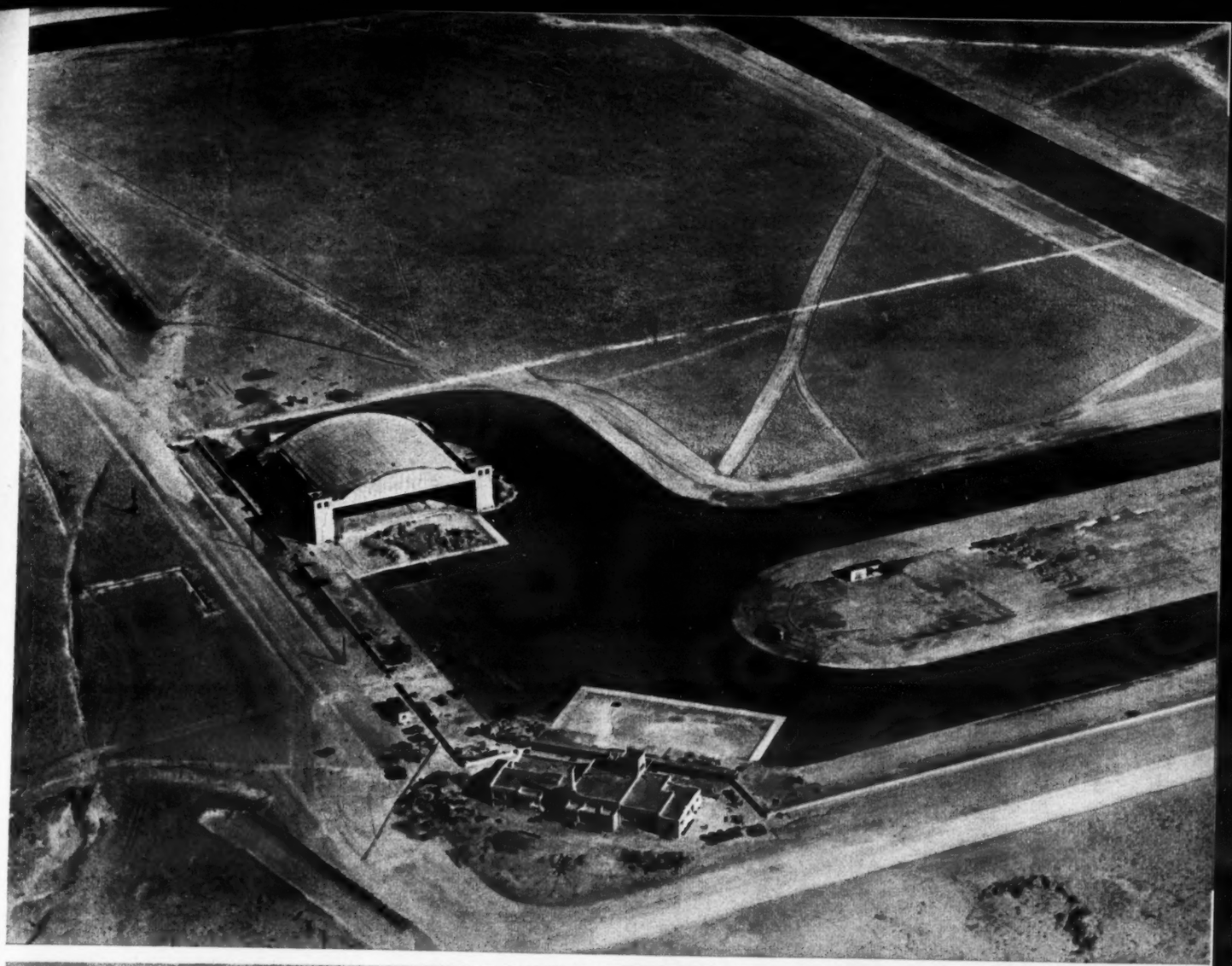
Albuquerque, New Mexico, is unique in a nation famed for its paradoxes. Though today one of America's most important air terminals, it has surrendered none of its leisurely, pleasant ways of life and its romantic, picturesque surroundings. Shining, multi-engined airliners constantly roar in to discharge smart New Yorkers and Hollywood celebrities. But only three and a half miles away, on the sidewalks of a modern city of some 65,000 inhabitants, Indians swathed in gaudy blankets shuffle along before the trinket-filled windows of a five-and-dime store, and cowhands in skin-tight levis and broad-brimmed sombreros stride awkwardly in their high-heeled boots.

At the time when the first white men set foot in the country, the Spaniards lured by legendary gold and silver in 1536, the Indians had flourished for over 600 years. Then there followed nearly 300 years of alternating peace and battle, until in 1822, the revolution gave Mexico her freedom from Spain. In 1846 the U. S. Army took over in the name of the Republic and 30 years later, the advent of the railroad assured swift development. In 1912, New Mexico became a State.

Today, there are 87 airfields in New Mexico, of which 14 are military air bases and 51 are minor aerodromes for private flying. Of the remaining 22 civil installations, eight have runways of 5,000 feet and over.

The largest of these, Albuquerque has developed in the space of few years. Its rise began back in 1938 when Transcontinental & Western Air, Inc., decided to show the industry the necessity of long-range airport planning. With the financial cooperation of the city and the Federal Works Progress Administration, TWA and the engineers staked out the airport in the shadow of the Sandria Mountain, on an 815-acre mesa, flat as a drumhead. With its low rainfall, the region offered ideal natural possibilities, the skies giving unlimited visibility month after month. After an expenditure of some $ 700,000, it was opened to air traffic in October, 1939. Operationally, the airport looked ahead. Though four-engined aircraft

(Above) Runways at Albuquerque. (Below) Albuquerquans watching a "Constellation" take off.



AIRLINE
Sky Chief
TWA

Ticket office at Albuquerque.

" Souvenir of New Mexico. " Indian trinket shop at the airport.

were not in general use, three runways of over 10,000 feet long were laid down and a fourth, 5,600 feet. (The largest runway at La Guardia Field, New York, is 6,000 feet.) Albuquerque received a boost during the war when the Army Air Corps expanded the airport to make it the largest in the world, spending $ 2,000,000 to extend the landing strips and erect new buildings, hangars and various amenities.

Prophetically, Albuquerque became in 1946 one of the alternate fuel stops for TWA's big transcontinental " Constellations ". And a recent month's operational figures illustrate the present heavy volume of traffic : 950 flights—an average of over 30 a day.

Meanwhile, planning did not end with the mere ability to handle a large volume of air traffic. Care was taken that the design of the administrative building should harmonise with the motif of the country, so that Spanish-Indian architecture with a splash of gay colours was chosen. The murals are the work of a celebrated Indian artist, Pop Chalee, who is no grizzled, Indian patriarch, as one might be misled to believe, but a young and pretty Taos Indian woman.

Albuquerque Airport, air gateway to the West, is best portrayed by the camera.

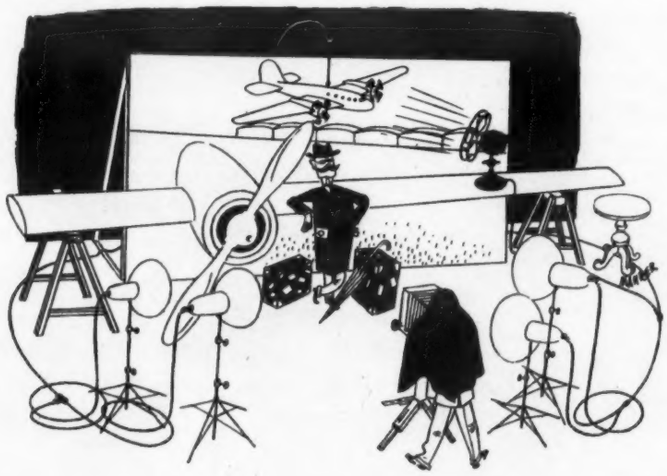
Strolling back over the luxurious patio which faces the runways, and through the main lobby into the restaurant, we again find our old friend Wilson, meditatively sipping his beer and looking around for a kindred soul to join him in a cowboy ballad. As a big transport roars in, and several Albuquerquans make for the runway in the hope of catching a glimpse of a Hollywood screen or Broadway stage star, he gives us a knowing look :

" Ya know, I rode one of 'em to Pittsburgh coupla years ago to visit my sister. Greatest experience I ever had. Why, if I was a few years younger, I might go in for it m'self. "

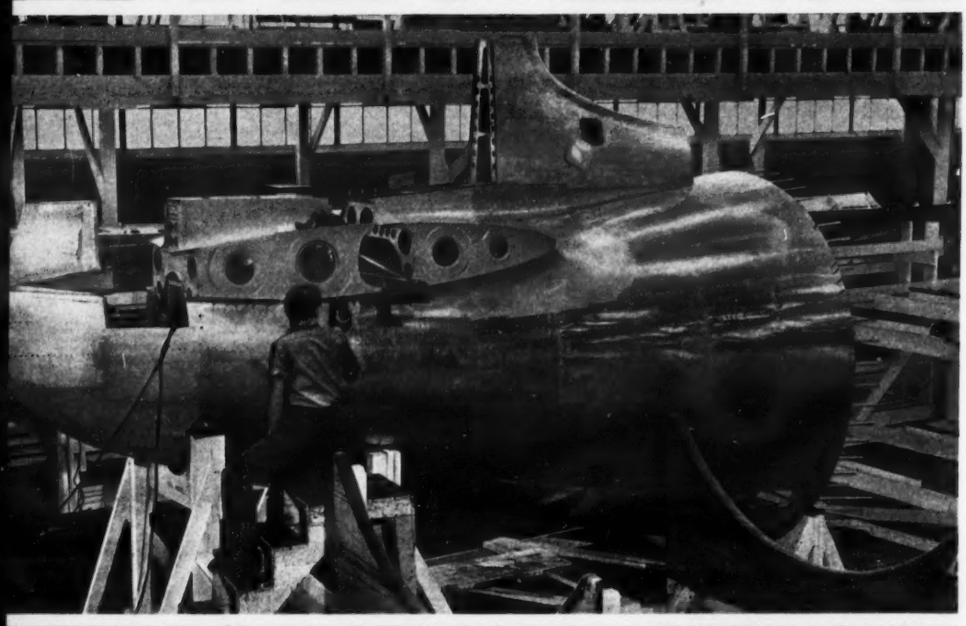
P. S.

Farewell view of Albuquerque.

Pop Chalee, the Indian artist responsible for the striking murals of the lobby and cocktail lounge.



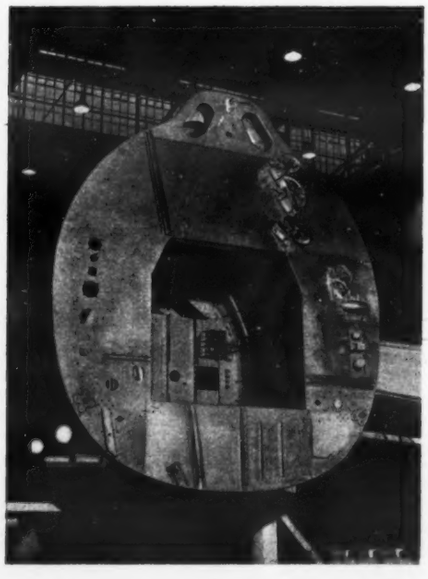
Before the prototype of the new *Martin 202* twin-engined transport took off for its first flight on November 22nd, 1946, in Baltimore, the manufacturers, *The Glenn L. Martin Co.*, already possessed orders for 350 units. The waiting list of contractors has since lengthened, featuring North and Central American passenger and cargo airlines as well as a whole number of South American carriers. Notwithstanding the fact that these orders are not yet firm, but contingent upon the aircraft's performance and certification by the authorities, it may all the same be said that never in the history of aircraft manufacture has their been such a demand for one type of commercial transport. During the war, when the armament programme placed inexhaustable funds at the industry's disposal, it frequently occurred that

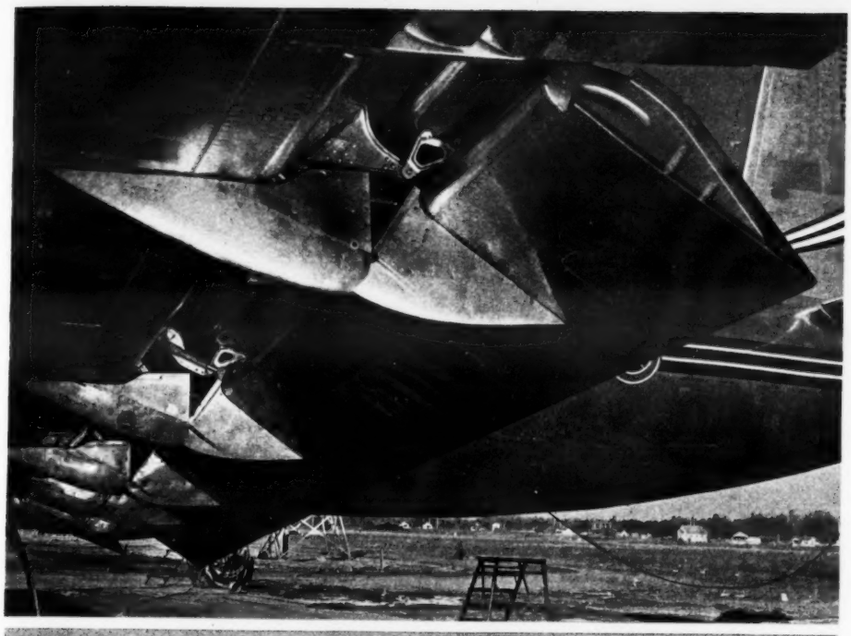


big contracts were placed before a prototype existed and while the aircraft was still in the drawing board stage. Meanwhile, commercial aircraft are bought by numerous and varied customers, so that a procedure of this sort is unthinkable. But the fact that, despite this, Glenn L. Martin has already obtained such a quantity of orders, is characteristic of the present situation : All the airlines of the world possess twin-engined transports, forming the nucleus of their flying equipment, which have been in operation for fifteen years and must sooner or later be replaced.

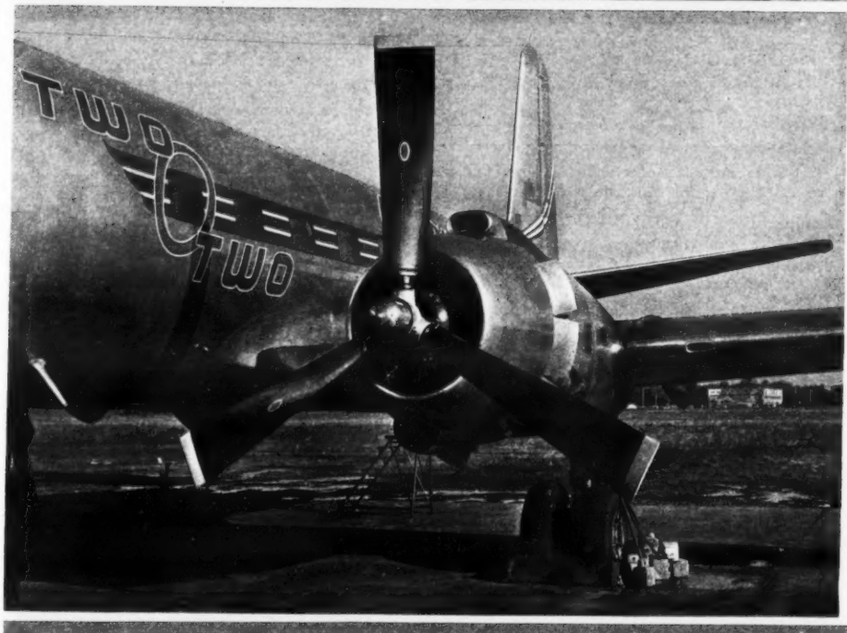
In 1943, when the Martin concern set itself the task of replacing the Douglas DC-3 by another twin-engined transport with a higher cruising speed and almost twice the payload—the Martin 202 is fitted to accommodate 36 to 40 passengers—they reckoned on this demand and renounced the construction of an actual prototype. In order to lose no time, a whole series was begun on right from the start. This series is already well advanced and Pennsylvania-Central Airlines, for instance, who have ordered fifty of the type, will be able to put the first Martin 202 into operation within a few months.

The design of the Martin 202 aimed not only at providing a high performance aircraft to suit the passengers' wishes, but also at a maximum simplicity of maintenance and servicing. Thanks to close collaboration with the operational staffs of several airline companies, various radically new features have been introduced, which are likely to be taken over in future by other aircraft firms. (A complete description of the Martin 202 is contained in "INTERAVIA, Review of World Aviation," June, 1946, P. 68.)





Top left : Landing flaps fully extended with narrow auxiliary flap. The top of the picture shows the attachment of the ailerons. Top : Built-in stairway at the fuselage rear, operated by the pilot.



The accompanying photos show the aircraft in various phases of its final assembly as well as a few constructional details. Worthy of notice is the self-contained stairway located beneath the fuselage rear ; operated from the cockpit, this feature means a considerable simplification for the ground personnel. Also novel are the double-slotted landing-flaps and the special Van Zelm ailerons. Power plant comprises two Pratt & Whitney R-2800 twin-row radials, each developing 2,100 H. P. for take-off, driving Hamilton Standard reversible-pitch four-blade airscrews of 13 ft. 1 in. in diameter with wide, rectangular blades. *Bi.*

Hamilton Standard reversible-pitch airscrew with rectangular blades.

ICAO Headquarters in Montreal.

Agenda for the First Plenary Session of ICAO

To begin on May 6th, 1947, in Montreal

I. The Participants:

On March 11th, 1947, the United States Department of State informed PICAO (Provisional International Civil Aviation Organisation) that 28 countries had ratified the Convention on International Civil Aviation. This meant that the organisation's provisional character was over with, and that the ICAO (International Civil Aviation Organisation) had come into being.

Counting the three countries whose instruments of adherence arrived after the apointed day (France, Holland and Iceland), the roster of Member States at present features the following:

Argentina	Holland	Poland
Australia	India	Portugal
Brazil	Ireland	Spain
Canada	Iceland	Sweden
Chile	Liberia	Switzerland
China	Mexico	Turkey
Czechoslovakia	New Zealand	Union of S. Africa
Denmark	Nicaragua	United Kingdom
Dominican Republic	Paraguay	U. S. A.
Ethiopia	Peru	
France	Philippines	

It is stated in the PICAO news release of March 11th:

> "It is understood that, in addition to the States named, six other countries have completed ratification procedure and their instruments of ratification are now being transmitted to Washington."

It is probable that the facts behind this communication are considerably less secretive than is given to believe.

As in the case of the three "dawdlers", France, Holland and Iceland, the remaining three countries will probably be among those who were represented at Chicago in 1944 and signed the Convention but have hitherto not ratified it.

It cannot concern Axis satellite states because article 93 of the Convention precludes their admission unless it is supported by a four-fifths majority vote of the plenary session. Also Italy, who was authorised to send observers to the PICAO meetings, would have to await favourable reply to a request for admission before she could deposit her ratification.

On the other hand, it cannot involve neutral countries, whose entry, according to article 92, would be possible without previous request. The above list contains almost all the neutrals of the last war.

People who believe in miracles might go so far as to think of Soviet Russia. But such a thought can scarcely be considered seriously. Russia's retentive attitude dates back to 1944, and her adherence seems highly improbable for the time being. So let's wait and see—and not expect anything extraordinary.

II. The Agenda:

1. *Constitutional and General Policy Questions.* Point 4 of the agenda assigned to the commission concerned involves a draft agreement with the United Nations and resolution of the United Nations Assembly concerning the membership of ICAO. This will entail the question of Spain's membership.

2. *Technical Questions* will deal with PICAO's work in the technical field and the adoption of the Organisation's decisions.

3. *Economic Questions.* Among other items, the competent commission will consider the draft of a Multilateral Agreement on Commercial Rights in International Civil Air Transport, prepared by the Air Transport Committee to order of the plenary session. (Details of this Agreement are contained in the article entitled "Freedom of the Air", by Dr. L. H. Slotemaker, to be found elsewehere in this issue; and also in last month's magazine in the article entitled "Sovereignty and Civil Aviation").

In addition, the commission has many other thorny problems to examine, such as the facilitation of international air transport (customs and landing rights, etc.), onerous economic burdens on international air transport (insurance requirements, double taxation, etc.), etc.

4. *Legal Questions.* Preliminaries to the constitution of a permanent Committee on International Air Law, which will succeed CITEJA, dissolved last November. Furthermore, the commission concerned will review CITEJA's work, and will particularly concern itself with the recommendation made at the body's last session in Cairo: Revision of the Warsaw Convention; legal status of the aircraft captain; recordation of title to aircraft and aircraft mortgages. (Cf. Vol. I, Nº 5: "Problems of International Air Law", by Major Beaumont and Commander Goodfellow; Vol. I, Nº 8/9: "Liquidation of CITEJA", by Colonel Louis Clerc). It will be recalled that CITEJA considered a revision of the Warsaw Convention as not being urgent; and the draft prepared by Major Beaumont only contained a few ameliorations of the text and an increase of the carrier's financial liabilities.

It is thus to be assumed that the Warsaw Convention will be left essentially intact. The fact is, indeed, that the epoch between the two world wars did not give sufficient time to both national and international codifications to ripen.

5. *Administrative and Financial Questions* will concern the action relating to the liquidation of PICAO and the transfer of its property to ICAO. The competent commission will regulate ICAO's internal organisation, provide it with a secretariat, and establish its first budget, which, according to the wishes of the President, Dr. Warner, should involve less expenditure than those of PICAO.

6. *Technical and Financial Aid Through ICAO.* The sixth and last subject deals with the aid which ICAO can give to countries towards ground organisation (Chapter XV, Art. 70 and 71 of the Convention on International Civil Aviation; cf. Vol. I, Nº 4: "The First Plenary Session of PICAO", by Colonel Clerc). Aid may be solicited by countries who must develop their ground organisation to an extent beyond their national requirements in the interest of world air transportation.

III. The Aim:

Dr. Edward P. Warner, in his "Notes from PICAO Experience" ("Air Affairs", September, 1946), reminds readers that both the Interim Agreement and the Convention of Chicago were conceived during the war. In 1944, the world was under the pressure of dreadful responsibilities, and had other things to think of beside the development of commercial aviation. Thus it is clear that both instruments still contain certain discrepancies, which it is the task of a future peace to smooth down.

No better send off could be given to the gentlemen who are to meet in Montreal than two sentences from Dr. Warner's lecture of January 10th at McGill University in Montreal:

What, in fact, is air transportation? The first essential fact about it is that it is an economic enterprise.

In common or garden English, it is a business. Hence, civil aviation should not be an object of political intrigue, national or international. And the sooner this is realised, the sooner it will thrive.

Dr. E. A. He.

NEPA Project

In the conclusions to his final report on the war activities of the U. S. Army Air Forces, General of the Army George C. Marshall, former Chief of U. S. General Staff, already alluded to the development of *atomic energy as a propellant for aircraft.* In March, 1946, Major-General E. LeMay, Deputy Chief of Air Staff for Research and Development, outlined plans for an Air Engineering Development Centre, with extensive facilities for research on nuclear energy and its use as a means to drive aircraft. Then, in July, 1946, a quieter but more significant announcement appeared in the daily newspapers : The U. S. Army Air Forces has awarded the *Fairchild Engine and Airplane Corp.*, of New York, a contract for research and experimental work on the application of atomic power for the propulsion of aircraft.

This was the formal beginning of the first attempt in America—and as far as is known, in the world—to apply nuclear energy as a propulsive force for aircraft.

Now, after a silence of seven months, comes an announcement that important initial progress had been made in a programme which may eventually revolutionise present concepts of aviation. The work has been given a name, the *NEPA Project,* NEPA standing for Nuclear Energy for Propulsion of Aircraft. Headquarters are at Oak Ridge, Tenn., site of the Clinton Engineer Works. Whilst the Fairchild concern is the main AAF contractor, it is associated with nine other aeroplane and engine firms [1] as well as with the National Advisory Committee for Aeronautics (NACA). Moreover, private laboratories, universities, and a staff of special consultants are all contributing to this huge research programme, so that minutely organised teamwork is essential if a duplication of efforts is to be avoided.

Fairchild has formed a special division, known as the NEPA Division of Fairchild Engineering and Airplane Corp., which has established working relations with the Monsanto Chemical Company, who operate the Clinton Laboratories and are working on a project to use atomic energy for stationary power plants.

Director of the NEPA Project is *Major-General Curtis E. LeMay ;* and *Gordon Simmons,* Jr., who carried through the construction of the plant for concentrating Uranium-235 at Oak Ridge, is Technical Director of the Fairchild NEPA Division. Chief Engineer is *Andrew Kalitinsky,* who was with Pratt & Whitney's before joining the Navy Bureau of Aeronautics.

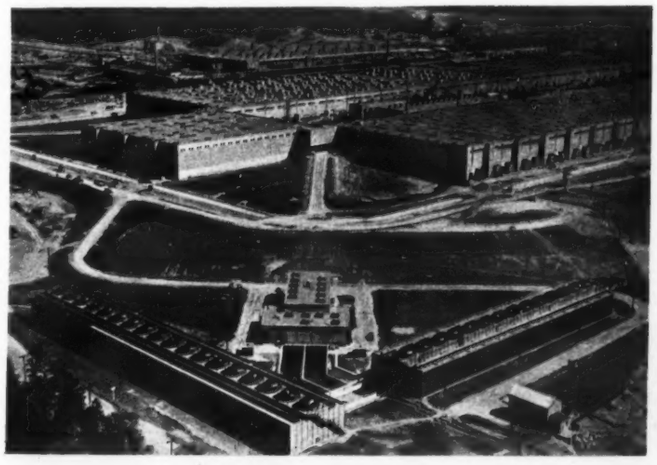
The Project is conducting research into the application of nuclear energy to various types of aero engine—open- and closed-cycle turbines, turbo-jets, ram-jets, and rocket devices—and the groundwork is being laid for the design of aircraft-type nuclear reactors. However, there is so far no indication that anything has reached the drawing board stage.

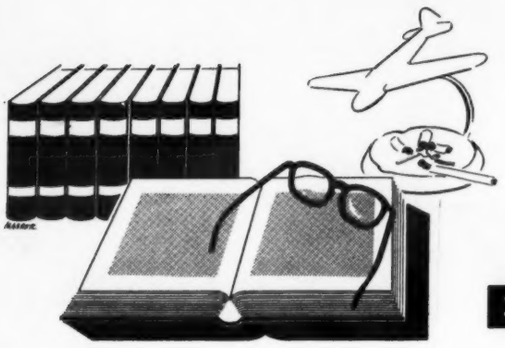
It is quite impossible to forecast when major results will be achieved. Nuclear science is a new field, and its problems are vastly complex. The enormous weight of shielding necessary to protect occupants against the deadly radiation presents a tough problem for the designer, and it is probable that the first attempt will have to be made with an unmanned aircraft guided by a mother plane, or else with remote-controlled aerial projectiles.

The only answer one can give to sceptics, whether scientists or laymen, is that aeronautics has provided perhaps more surprises than any other branch of science. It is by no means its first entry into an unexplored field, and it has so far never admitted failure. *P.S.*

[1] Allison Engine Division of General Motors ; Continental Motors Corp. ; Fredric Flader, Inc. ; Lycoming Division of Aviation Corp. ; Menasco Manufacturing Co. ; Northrop Aircraft, Inc. ; Pratt & Whitney Aircraft Division of United Aircraft Corp. ; Westinghouse Electric Corp. ; Wright Aeronautical Corp.

Air view of one of the large plants of the Clinton Engineer Works in Oak Ridge, Tennessee.





Book Review

Saint-Exupéry, Essai. By R. M. Alberes. La Nouvelle Edition, Malakoff (Seine).

Saint-Exupéry was not a writer by profession. " I'm an airman ", were his words to the press. And it is with these words that R. M. Alberes begins his study of Saint-Exupéry, which familiarises one with the life, work and writing of this airman who fell during the last war. Whereas in the unforgettable books, " Courrier Sud ", " Vol de Nuit ", " Terre des Hommes " and finally " Pilote de Guerre ", the reader sees the evolution of the man and the airman, Alberes shows, almost unnoticeably, the position which the deceased has assumed in a generation of aviation writers which is now decimated and growing old. (French.) EH.

Travaux du Laboratoire Aérodynamique. By Prof. Elie Carafoli, D. Sc. Printed and published in 1938 by M. O., Imprimeria Nationala, Bucharest.

The first part is a brief description of the wind tunnel at the Aerodynamics Institute of the Bucharest Technical High School, put into operation in 1931.

The main part consists of a list of measurements taken with a large number of airfoils : among others, airfoils with infinitely small trailing edge angles, certain with measurable angles, and airfoils with rounded trailing edges. (French.) Ba.

Météorologie et Navigation Aérienne. By C. Barté. Edition Berger-Levrault, Paris, 1946.

This manual on practical meteorology was written in 1944 for French Air Force crews by a professional meteorologist. The author, today holder of the chair for meteorology at the French Ecole de l'Air, emphasises in a simple manner the importance of meteorology to flight safety. He confines himself to a few of the most important phenomena (winds, cloud formation and atmospheric disturbances), so that an easily understandable account ensues, which requires no recourse to advanced physics and mathematics.

Informed on the importance of collaboration between weather service and crew, the pilot is then instructed in the reading of weather maps. Barbé draws practical conclusions from daily meteorological reports, and describes the dangers represented by icing, fog, turbulence and lightning, explaining how these dangers can be anticipated in good time and avoided. There are 34 diagrams, two maps, a weather code and numerous photos of cloud formations. (French.) Dr. B.

Strength Calculations for Aircraft (Protschnost Samoljota). By S. N. Kahn. Published in 1946 by Oborongis, Moscow.

This text book on strength problems in aircraft construction was written for participants in the superior training course for aeronautical engineers at the " Joukovski " aerial warfare academy. Beginning with an extensive account on different loads and prescribed overloads, Kahn goes on to the subject of wing construction and its elements, giving calculation and dimensional figures for metal and wooden designs. He deals very thoroughly with ailerons and lift-increasing flaps, as well as with the calculation and designing of control surfaces, fuselages, and engine mountings. A great deal of space is devoted to the dimensioning of undercarriages, whereby the various calculation methods used in Russian aircraft construction are mentioned. The last chapters deal with wing oscillations, and can be applied to practical conditions. Although the book contains all the most important formulae, the author has left out the mathematical derivations and theoretical considerations, with the result that the engineer is presented with valuable constructional data in the form of diagrams, tables and graphs. — 229 pages and 270 illustrations. (Russian.) E. N.

Wing Construction in Modern Aircraft (Konstrukzija Kryla Sowremjennowo Samoljota). By N. A. Formin. Published in 1946 by Oborongis, Moscow.

A brief historical preface is followed by an account of the most important types of wing construction, including Russian designs. In dealing with the basic aerodynamic data, the author includes the Russian ZAGI-B series of airfoils. After a thorough treatment of the relations between wing forms and flight characteristics, there is a description (with profuse illustrations) of the various loads for biplanes, strut-braced monoplanes and—especially thorough—for cantilever monoplanes. Moreover, a long list of references will find the interest of Western engineers. — 188 pages, 162 diagrams and numerous tables. (Russian.) E. N.

Moteurs d'Avions. By R. Marchal. Published in 1946 by Dunod, Paris.

This work is essentially the author's lectures on aero engines at the National Aeronautical Institute in Paris, in book form. It is written primarily for students of engineering, and gives the fundaments of aero engine design and construction. As regards volume, it is probably one of the most extensive books ever written on aero engines : apart from a brief introduction to general thermodynamics, it deals separately with engine thermodynamics, the problems in kinematics and dynamics, strength calculation, etc. Certain chapters are devoted to ignition, lubrication, fuel mixtures, as well as supercharging and the calculation and construction of superchargers. Furthermore, the author deals with practical questions concerning construction and final adjustment, together with methods of installing the engine in the aircraft ; another chapter contains descriptions of currently-used test equipment and methods. It is a book which is of value not only as a student engineer's text book, but also as a reference work for factory designers ; the tables and graphs in the second volume will find wide appeciation in the latter instance. It may be added that all calculations and derivations are based on the not often used MTS-System (Metre, Ton, Second). — Volume I contains 644 pages and 492 illustrations ; Volume II, 124 pages with numerous tables and graphs. The price of both volumes is 3,200 francs. (French.) F. P.

La Plan de Fabrication Aéronautique. By M. P. Guibert. Published by Dunod, Paris.

This publication is a valuable addition to European aeronautical literature which contains such meagre information on the technical organisation of aircraft manufacture, and it enables the reader to draw comparisons with corresponding activity in U. S. firms. Patterned to suit European requirements, the book deals with general questions on manufacture, production planning, and line assembly of aircraft, notably of airframes.

The author refers to the existing deficiences in the organisation of aircraft manufacture and gives a few tips on how to eliminate errors in the process of production by using numerical values based on statistics ; he champions a rationalisation of the production process. (French.) Ba.

Schweizerisches Flugplatzrecht. By Dr. M. Köpfli. Archiv für Luftrecht, Aeroverlag, Zurich.

Apart from certain traffic control regulations, airport law is largely subject to national legislation. This book begins with the grounds for state influence in the erection and operation of airports : on the one hand, protection against violation of public security ; on the other hand, political interest in the development of transportation. The second part of the book contains a multitude of legal questions, thus providing a valuable reference work for those in the branch. (German.) Bi.

Vingt-Cinq Années d'Aviation militaire. By Brigadier-General J. Hébrard. Editions Albin Michel, Paris.

The first volume by this well-known French Air Force officer is sub-titled " Facts Leading Up to the Collapse of the French Air Force in 1940 " and deals with the development of the French and German Air Forces, from material and tactical aspects, from 1920 until the war. The author endeavours to investigate the reasons for which, despite considerable financial allocations, the French Air Force was inadequately equipped at the outbreak of hostilities. The second volume, " War in the Air, from 1939 to 1945 ", begins by describing the rôle of the air forces in the campaigns against Poland and France, and then continues with the various development phases of the Allied air forces and the variations of their strategic and tactical operation. Hébrard concludes by bringing up those questions which were discussed already fifteen years ago in Geneva : internationalisation of aviation ; establishment of an international airborne police force. (French.) Bi.

THE MONTH IN REVIEW

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POLITICAL

● The *British Military Air Estimates* for 1947-48 provide for a total of £ 214,000,000 (£ 255,500,000 for 1946-47) : £ 70,928,000 are allotted to Technical Supplies and Services (aircraft, spare engines and airframes, components, radio, radar, fuels, etc.), compared with £ 20,983,000 in the previous year. In the Ministry of Supply estimates, £ 82,200,000 are included for aircraft and aircraft equipment, £ 115,024,000 less than the previous year's figure.

● *Achille van Acker*, one-time Prime Minister, is *Belgian Minister of Transport* in Paul H. Spaak's new Government.

● The *Norwegian Budget Estimates* for 1947-48 provide Nor. Kr. 8,340,000 for civil aviation : Kr. 2,020,000 are for landplane and marine landing facilities, and Kr. 6,080,000 for air safety measures.

● During the debate on the Hungarian Budget Estimates for 1947, Transport Minister Gerö was criticised for not having considered an offer made by Pan American Airways in 1946 to assume responsibility for the re-equipment of *Budapest-Feribegy Airport* in return for certain landing rights.

● *Bilateral Air Agreements* have been concluded between the following : Sweden and Portugal, March 6th ; U. S. A. and Siam, Holland and Turkey, both on March 20th. Negotiations are being conducted by Russia with Czechoslovakia ; and the U. S. A. with Ceylon. The Indian Ambassador to China, K. P. Menon, is reportedly to initiate discussions between these two countries.

NEW AIRCRAFT

● The *North American XSN 23-1* is a new two-seater trainer developed for the U. S. Navy by North American Aviation Inc. It is powered with a Wright Cyclone 9 air-cooled nine-cylinder radial of 1,100 H.P. for take-off.

● The *Grumman F7F-3N "Tigercat"*, twin-engined carrier-borne fighter of the U. S. Navy and latest long-range version of the "Tigercat" series, is characterised by a peculiar nose section which may possibly contain radar equipment.

● The *Consolidated Vultee 240* twin-engined transport prototype was subjected to a final test flight of 1 hr. 54 min. on March 16th. Deliveries are scheduled to begin this summer.

* Abridged excerpts from Nos. 1279 to 1290/91 (March 8th to April 3rd, 1947) of "INTERAVIA, International Correspondance on Aviation", an illustrated newsletter published three times weekly in four separate language editions, English French, Spanish and German.

Martin XB-26H.

● The *SAAB-90 "Scandia"* twin-engined commercial transport of Svenska Aeroplan A.B. was granted its type certificate by the Swedish Air Board on March 8th, following the completion of its prototype tests. This prototype subsequently made a demonstration tour of various European countries.

● The prototype of the *Airspeed A. S. 57 "Ambassador"* twin-engined commercial transport is nearing completion at the Christchurch plant of Airspeed Ltd. Initial tests are to start this spring.

● The *Percival P. 50 "Prince"* is an eight to ten-passenger twin-engined transport projected by Percival Aircraft Ltd., of Luton, Beds., which can be described as a somewhat enlarged version of the twin-engined "Merganser" of the same firm. It is intended to fit it with two Alvis "Leonides" air-cooled nine-cylinder radials of 505 H.P. for take-off, which would give it nearly twice the power of the "Merganser".

● The prototype *SO 94*, 10-passenger twin-engined feeder transport developed by the French national *S. N. C. A. du Sud-Ouest* aircraft concern, was recently subjected to its first test flight over the firm's airfield at Villacoublay.

● The *Martin XB-26H* is a modified version of the Martin "Marauder" twin-engined medium bomber with which The Glenn L. Martin Co. is conducting experiments to study a new type of landing gear arrangement. This comprises two main wheels mounted in tandem in the fuselage underside, similar to the arrangement projected for the Martin B-33 "Supermarauder" four-engined bomber, and two lateral auxiliary wheels under the engine nacelles ; all four wheels are retractable.

● The *United Helicopters UH-4 "Commuter"*, a two-seater helicopter developed by United Helicopters Inc., Palo Alto, Calif., was unveiled to the public on March 18th. Powered with a 135-H.P. Lycoming air-cooled flat-four, it reportedly attained a cruising speed of 90 m. p. h.

● The prototype of the *Macchi M.B. 308*, a two-seater high-wing cabin monoplane built by the Italian Aeronautica Macchi S. A., is being subjected to its type-requirement tests.

● The *Martin 202* twin-engined transport is to have a military counterpart, according to its manufacturers, The Glenn L. Martin Co.

INDUSTRY

● The *sales income for 1945 of the eleven major U. S. Aircraft firms* amounted to $ 3,530,000,000, according to Major-General Echols, President of the Aircraft Industries Association. The aggregate sales of these firms was below $ 500,000,000 in 1945, with eight concerns working at a loss.

● *Grumman Aircraft Engineering Corp.*, of Bethpage, L. I., have had to dismiss 950 employees following completion of the Navy contract for "Tigercats". Further dismissals are not anticipated as production of the "Widgeon" and "Mallard" amphibians is continuing.

● *Beech Aircraft Co.*, of Wichita, Kansas, exported $ 2,740,000 worth of aircraft in 1946. All Beechcraft 18 S twin-engined feeder transports destined for Canada, Mexico, Costa Rica, Brazil, Argentina, Dominican Republic, Egypt, India, Holland, Turkey, England, Panama, Alaska and Guatemala were delivered by air ; extra fuel tanks were fitted for Atlantic crossings.

● *Douglas Aircraft Co.* delivered the first two certificated Douglas DC-6 four-engined airliners to United Air Lines and American Airlines at the firm's Santa Monica plant on March 28th.

Grumman F7F-3N "Tigercat".

United Helicopters UH-4 "Commuter".

● The Aircraft Industries Association of America is to sponsor another *National Aircraft Show* next Autumn, probably either in Chicago or New York ; the show will concentrate on light aircraft.

● *The Glenn L. Martin Co.* has acquired assets and patents of *Rotawings Inc.*, a helicopter development enterprise in Philadelphia. A new Rotawing Division of Martin's will have its headquarters at North Wales, Pa., and continue the development work of the firm acquired (research on helicopter control systems, blades, hubs, etc.)

● *English Electric Co. Ltd.*, whose aviation activities include production of de Havilland " Vampire " jet fighters and control of D. Napier & Son. Ltd., aero engine manufacturers, reported a net profit of £ 492,775 for 1946 (£ 442,668), on which an unchanged dividend of 10 percent was declared.

● The *Dornier-Flugzeugwerks* facilities at Manzell, near Friedrichshafen, are being demolished by decree of the Allied Control Commission.

● The *Union de matériel d'équipement aéronautique*, association of French undercarriage manufacturers, has been joined by S. N. C. A. du Centre (French licensee of Dowty Equipment Ltd., the British firm), so that it now comprises the entire French landing gear manufacturing industry.

RESEARCH

● The *University of California* is building two *supersonic wind* tunnels, with test chambers measuring 1 in. × 3 in. and 3 in. × 3 in., which are specially designed to simulate extreme altitude conditions (70,000 ft. and 50 miles) and speeds up to 3 Mach and over 5 Mach.

● The U. S. *National Advisory Committee for Aeronautics (NACA)* is completing a research programme on *thermal anti-icing* at the Ames Laboratory, Moffat Field, Calif. It is hoped, before the end of 1947, to supply aircraft firms and airlines with definite data on anti-icing equipment for conventional airfoils.

INDUSTRIAL PERSONALITIES

● *George Dowty*, Managing-Director of *Dowty Equipment Ltd.*, has been appointed *Chairman* of the Board in place of the late A. W. Martyn.

● *Robert W. Lea*, President of the Johns-Manville Corporation, has been elected to the Board of the *Curtiss Wright Corporation.*

● *James Stanton*, hitherto Press Relations Officer of the Society of British Aircraft Constructors (SBAC), has been appointed *Public Relations Director for Great Britain and Europe* for the *Lockheed Aircraft Corp.* He is replaced in the SBAC by Flight Lieutenant E. A. Wren, formerly editor of the British Air Ministry's " Aircraft Recognition Journal ".

INTERNATIONAL ORGANISATIONS

● ICAO : Following the deposition of 28 ratifications of the Convention on International Civil Aviation, PICAO discarded the prefix "Provisional", and assumed its rôle as the *International Civil Aviation Organisation* on April 4th. The agenda for ICAO's first meeting in Montreal on May 6th is dealt with elsewhere in this issue. — *Regional Air Navigation Meetings : South America :* June 17th, 1947, in Lima, Peru ; *South Atlantic :* July 15th, 1947, in Rio de Janeiro ; *South East Asia :* December, 1947, in India ; *North Pacific :* October or November, 1947, in China : *African-Indian Ocean :* date and place as yet undetermined.

● *IATA :* The *Traffic Committee* met in Nice from March 4th to 8th, and discussed the new distribution of traffic areas decided at the Association's last Annual Meeting in Cairo (four instead of nine Regional Conferences), as well as a standard waybill consignment note, the payment among IATA members to each other of the same commission on inter-line sales as payable to travel agents, experimental rates for air freight as distinct from air express, etc. The Traffic Committee will meet next on October 7th in Rio de Janeiro, one week before the IATA *Annual Meeting* in the same city.

● *IMO :* The *International Meteorological Organisation* has called a conference of the heads of the national weather services in Washington for the time from September 22nd to October 7th. An international weather service agreement is to be considered.

● *ISO :* The *International Organisation for Standardisation* is currently forming its Secretariat-General in Geneva, and projects the formation of 64 Technical Sub-Committees, including one for Air Affairs.

EXHIBITIONS

● An *International Aeronautical Exhibition* is to be held in Utrecht from May 16th to 22nd, 1947. Belgium, France, Great Britain, Poland and Switzerland have already announced their participation.

AIR TRANSPORTATION

● *North Atlantic : American Overseas Airlines* has been flying its services to Scandinavia (twice weekly to Copenhagen, once weekly to Oslo) by way of Keflavik, Iceland, instead of Shannon, since March 15th. — *Pennsylvania-Central Airlines* has cancelled its contract with the Air Transport Command of the USAAF for the operation of a trans-Atlantic courier service ; ATC was unable to supply spare parts and other material for the aircraft, as stipulated in the contract. — The Belgian *Sabena* intends to re-open its Brussels — New York service on June 15th. — *United States airlines* operated 84 percent of all trans-Atlantic flights and carried 86 percent of all passengers during 1946, according to the CAB. — The *15 percent transport tax* imposed on all U. S. airline tickets has been *abolished for flights from the U. S. A. to Europe ;* by order of the U. S. Government tax authorities, this measure has been effective since April 1st.

● *Profits in 1946* were realised by *only eight U. S. domestic airlines :* Braniff Airways, Continental Air Lines, Eastern Air Lines, Hawaiian Airlines, Mid-Continent Airlines, National Airlines, Northwest Airlines, and United Air Lines.

● A request by the sixteen leading U. S. airline companies to *raise all domestic air fares by ten percent* has been approved by the Civil Aeronautics Board.

● The Air Correspondent of the London " Daily Telegraph " draws interesting comparisons between *British and U. S. civil aviation operations in 1946 :* British scheduled carriers flew 434,400 passengers, whilst in the U. S. A. over 13,000,000 were carried.

● *Aerlinte Eireann Teoranta* was founded on March 1st as the third Irish government-controlled airline. Capitalised at £ 5,000,000, it is a subsidiary of Aer Rianta Teoranta, and thus has the same relation to the latter as Aer Lingus Teoranta. The new company is to operate Atlantic service and for this purpose will receive the Lockheed " Constellations " ordered by the parent company.

● *British European Airways Corp.* plans forming a *Cargo Section* within its Continental Division ; equipment would consist of short-nose Vickers " Vikings ". The plan follows the abandoning of a Cargo Division project, caused by the British Treasury's refusal to sanction the purchase of eight " Dakotas ".

● Provisional statistics released by the French Secretariat-General for Civil Aviation disclose the following figures on *Air France operations* in 1946 : 14,679,900 miles flown (all French carriers, 15,722,500) ; 285,700 (299,200) paying passengers ; 9,243,900 lbs. (9,249,600 lbs.) of mail, and 11,201,700 lbs. (13,494,500 lbs.) of freight.

AIRLINE PERSONALITIES

● *Charles S. Cheston* and *Thomas M. Conroy* have been nominated to the *Board of American Airlines Inc.* to replace Chandler Hovey and Charles Rheinstrom, who resigned.

● *René Briend*, Deputy Managing-Director and Commercial Manager of Air France, has been made a *Chevalier de la Légion d'Honneur.*

● *Charles L. Gallo*, formerly General Manager of TACA, the Central American carrier, has been appointed *Director of Traffic* for the *International Division of Trans World Airline.* His predecessor, Dean J. Hanscom, has joined Northwest Airlines.

SERVICE AVIATION

● *Curtailments in the U. S. Army Air Reserve training programme*, caused by cuts in military allocations in the U. S. Budget, involve the cessation of training at 29 airfields and consequently the reduction to 41 of Air Reserve training establishments.

● *Royal Air Force training bases* are to be set up on *Cyprus.* Permanent bases will be established at Porphon and Arnauti, and a temporary base at Nicosia.

● The *Turkish Air Force has received 400 British aircraft* and has been provided with a number of R. A. F. advisers, according to a Parliamentary statement.

MILITARY PERSONALITIES

● *Lieutenant-General Ira C. Eaker*, Deputy Commander of the USAAF and Chief of the Air Staff since April 30th, 1945, *retires on June 15th, 1947.*

● *Major-General Jean Louis Piollet* has been appointed Chief of the Air Staff and *Commander-in-Chief of the French Air Force.*

Covers for Volume I (1946)

Our subscribers may now avail themselves of binding covers *finished in imitation leather with gold lettering, specially prepared for the nine issues published in 1946. Price : U. S. $ 1.50 or 8 s. (postage included), Orders are filled immediately upon receipt of payment.*

An index *to Vol. I (1946) will be enclosed with the May, 1947, issue (No. 5), which subscribers will be able to bind together with the 1946 issues.*

Geneva, April, 1947. *The Publishers.*

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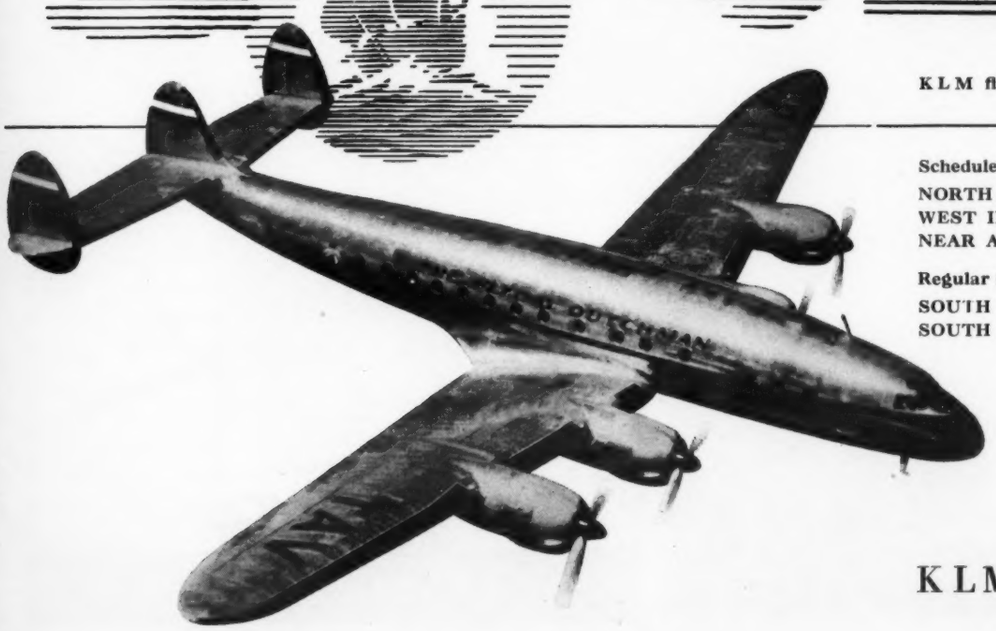

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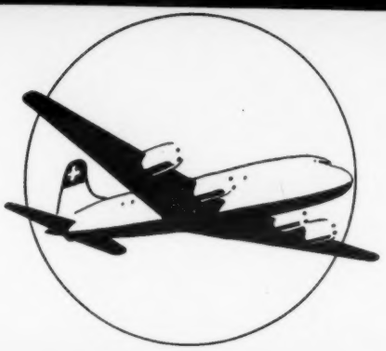

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